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STUDY

Renewable Energy for the Middle East and North Africa

Policies for a Successful Transition

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- The Middle East and North Africa hold the world's greatest potential for renewable energy, but at present renewables contribute only a mere one per cent to the region's primary energy mix. In addition to environmental and other benefits, renewables have a long-term economic advantage over non-renewable energy carriers. Embracing the benefits and deploying renewables requires the adoption of appropriate policies at the national level.

- Non-renewables must be used to accompany the transition towards a renewable energy supply. For both economic and environmental reasons, natural gas appears as the best-suited non-renewable energy carrier to assume this role.

- The transition towards a renewable energy supply requires some form of government intervention so as to overcome market distortions favouring fossil fuels. Subsidies for fossil fuels pose a significant barrier to renewable energy and thus ought to be phased out. There are several ways to promote the introduction of renewable energy, which allows for flexible designs according to the respective needs of each individual MENA country.

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1 Introduction

This paper seeks to present polices for the successful transition of the energy supply in the Middle East and North Africa (MENA) to renewable energy. The vast potential for renewables in the region remains unexploited, as only one per cent of the MENA region's primary energy mix is supplied with energy from renewable sources.[1] Given that the MENA region holds the world's largest fossil fuel reserves, this might appear obvious. At the same time, however, the MENA region also has the greatest potential for renewable energy in the world.

Like other countries, MENA countries must somehow respond to the fundamental global energy and environmental challenges of our time, namely the massive increase in global energy demand and climate change to which the use of non-renewable energy is significantly contributing. The International Energy Agency forecasts that compared to 2009, global primary energy demand will increase by almost 40 per cent by 2035. While in Africa energy demand is expected to grow »only« by some 38 per cent, the Middle East will consume almost 70 per cent more energy by then. Energy-related global greenhouse gas emissions are expected to grow 20 per cent globally by 2035 compared to 2010. In the MENA region, the estimated increase in energy-related greenhouse gas emissions is substantially worse – 47 per cent just in the Middle East.[2] These figures are more alarming if put in comparison. On average, the MENA region emitted some 27 per cent more CO_2 per capita in the process of fuel combustion in 2009 as compared to the world average.[3] The pattern is similar when it comes to the use of energy. In order to produce the same unit of value, in 2008 MENA countries needed twice the amount of energy as compared with the world average and even 3.7 times more energy than the OECD average.[4]

The MENA region's greenhouse gas emissions and overconsumption of almost exclusively fossil fuels are significantly contributing to climate change. In return, climate change is having very negative effects on the MENA region, too. Economically, it affects resources, infrastructure, and labour productivity. For example, temperature increases and rarer, but more severe, rainfall cause both more droughts and greater flooding and are thereby having a severe negative effect on agriculture.[5] These economic impacts of climate change make themselves felt socially by negatively affecting poverty reduction efforts, health, gender equality, and social inclusion. In essence, those who are already poor and worse-off are disproportionally affected by the negative effects of climate change. In the MENA region as elsewhere, adaptation measures to climate change are likely to be extremely costly.[6]

The good news is that by embracing *sustainable energy*, MENA countries are in a position to respond to these challenges in a way that offers not only environmental but also long-term economic benefits. The central question here is how to manage the transition to sustainable energy in the MENA region. Increasing energy efficiency and the number of energy-saving measures as well as switching the energy mix towards renewables are obviously the key.

This paper discusses, from a politico-economic perspective, how *renewable energy* can be promoted in the region to this end. While references to other uses of energy are made, the paper's focus is on the electricity sector. Taking into consideration the dominance of fossil fuels in the regional discourse, the paper seeks to present *the potential and manifold advantages of renewable energy in the MENA region*, *a proposal for the transition towards a renewable energy supply*, as well as *policy instruments for the deployment of renewables*. It is not the goal of this paper to come forward with a detailed renewable energy strategy for a particular MENA country or even the entire region. Rather, it strives to bring the question of renewable energy to the attention of policymakers and the interested public. The paper's suggestions are meant to be

1. Author's calculation based on IEA 2011a.

2. Author's calculation based on IEA 2011b, 81, 101.

3. Author's calculation based on IEA 2011c, II.4-II.6, II.35-II.43.

4. Author's calculation based on IEA 2011d, 48-57.

5. There are substantially more negative effects of climate change on Arab countries, as a draft version of a World Bank report notes: »Higher temperatures and more frequent and intense heat waves, threatening lives and crops; Higher air temperatures leading to loss of terrestrial biodiversity and increased acidification of oceans, impacting marine ecosystems and fisheries; Loss of winter precipitation storage in snowmass, inducing summer droughts; Less but more intense rainfall, causing both more droughts and greater flooding; Increased frequency of prolonged droughts loss of livelihood, income and reduced well-being; Sea level rise, threatening river deltas, coastal cities, wetlands, and small island nations such as Comoros and Bahrain with storm surges, salinized water, and flooding; More intense cyclones; Loss of coral reefs; New areas exposed to dengue, malaria, and other vector and waterborne diseases; Reduced education attainment, especially of girls, due to higher travel times to fetch water; Increased number of sick days for people due to diseases both to old and new diseases.« See World Bank 2011, 3.

6. World Bank 2011, 1-18.

a stimulus for the discussion on the future energy supply in the MENA region.

The arguments of the paper unfold as follows. In the second section, the status quo of renewable energy in the MENA region as well as its potential and benefits are discussed. The third section proposes how the transition towards a renewable energy supply in the MENA region can be managed, while the fourth section presents policy instruments supporting the deployment of renewables.

2 Assessing the Status Quo: Renewable Energy in the MENA Region

- **Renewables are thus far only marginally used in the MENA region. Their share in the region's primary energy mix amounts merely to one per cent.**

- **The prospects for renewables are great, as 45 per cent of the world's potential for renewable energy lies in this region.**

- **Beyond environmental benefits, there is also a long-term economic case for the use of renewable energy.**

- **Additionally, renewable energy can – among other things – increase energy-supply security, create a substantial number of jobs, and contribute to the electrification of rural areas.**

2.1 The Current Use of Renewable Energy

The current use of renewable energy in the MENA region is marginal. In 2008, only one per cent of the region's primary energy consumption was supplied by renewable energy carriers. In two-thirds of the MENA countries, the renewables share in the energy mix is one per cent or less and one-third of the region's countries are practically not using renewable energy at all. Tunisia is the region's leader in renewable energy with a 13.6 per cent share. Only six other countries meet more than one per cent of their primary energy demand with renewables (Egypt, Israel, Jordan, Lebanon, Morocco, and Yemen) but in none of these countries does the share exceed five per cent. Renewable energy is least used in the Gulf region. Yemen (1.3 per cent), Iraq (0.9 per cent), and Iran (0.5 per cent) are marginally using renewable energy, but all other countries in the Gulf effectively did not use energy from renewable sources at all in 2008 (see figure 1 on next page).[7]

While the present role of renewables in the MENA region is already marginal, the overall trend is even worse. In the decade 1999-2008, the renewable energy share in the overall MENA primary energy mix decreased by almost half, from 1.7 to 1.0 per cent. Only Iraq, Israel, Jordan, and Lebanon increased their shares of renewable energy in their primary energy mixes. In Algeria and Libya, the renewables share remained roughly at the same level while it decreased in Egypt, Iran, Morocco, Syria, Tunisia, and Yemen – in some cases substantially. Also in absolute terms, the picture does not look substantially better. While the MENA region as a whole was able to increase its absolute consumption of renewables by five per cent, the absolute renewable energy consumption remained at the same level in Lebanon, Libya, Tunisia, and Yemen, with Algeria, Iran, and Syria even seeing a decline in their absolute amount of renewable energy use.[8]

With this very modest use of renewables, the MENA region substantially lags behind the world average (see figure 2 on next page). In 2008, the world average for the share of renewables in the primary energy mix was 12.9 per cent, which is substantially higher than the MENA average of one per cent. While the global share of renewables decreased from 1999 to 2008 (from 13.7 to 12.9 per cent), this drop was moderate compared to the MENA region, where the share was almost halved.[9]

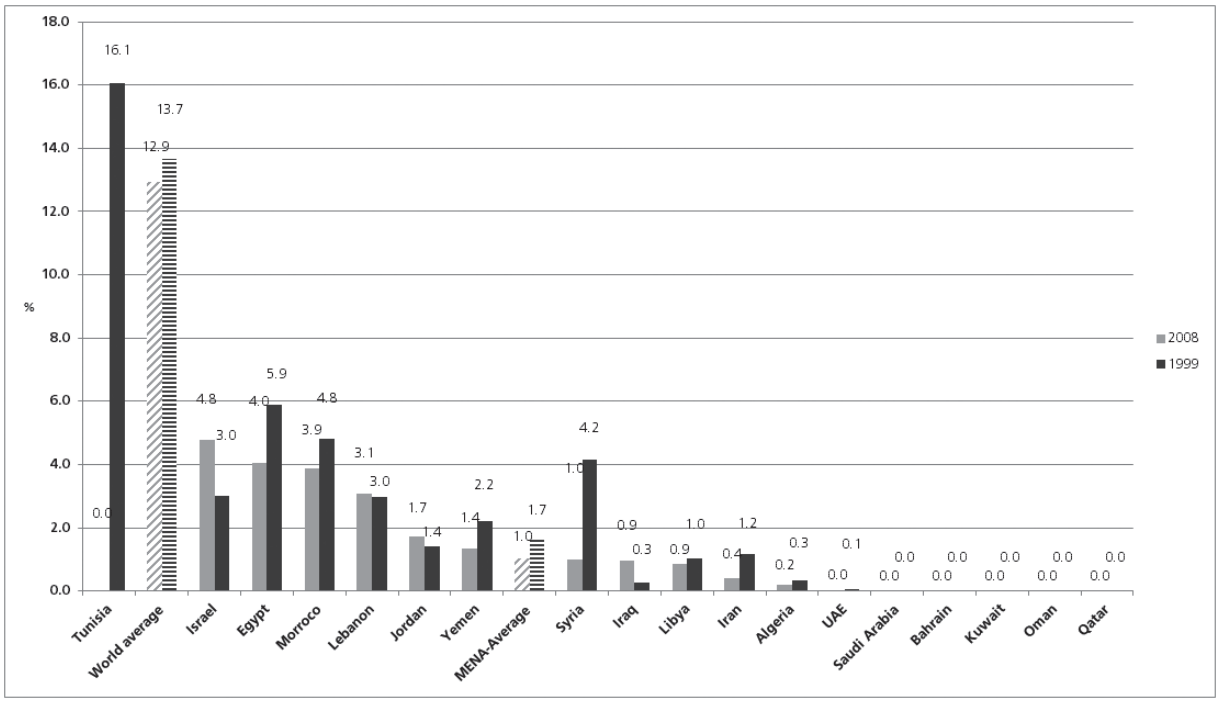
The obvious but nevertheless central observation here is that the MENA countries have not met their rapidly increasing energy demand with renewable sources. During the mentioned period of 1999 to 2008, the MENA region witnessed a massive increase in energy demand with absolute consumption rising by 66 per cent. At the same time, however, the absolute use of renewables only increased by five per cent. While energy demand increased faster than the use of renewables also on a

7. Author's calculation based on IEA 2011a and previous editions of this report.

8. Ibid.

9. Author's calculation based on IEA 2011a and previous editions of this report; IEA 2011e and previous editions of this report.

Figure 1: Renewables Share in 1999 and 2008 MENA Primary Energy Consumption



Source: Author's compilation based on IEA (2011e), Energy Balances of Non-OECD Countries, Paris: International Energy Agency.

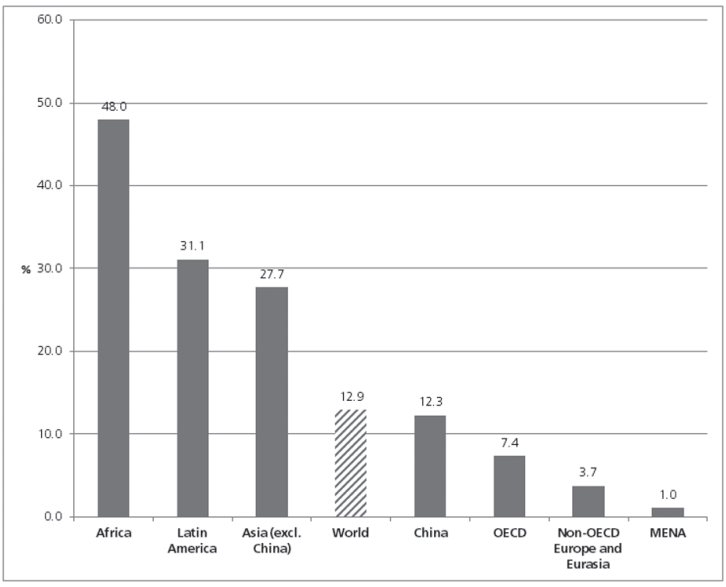
global level, the absolute use of renewable energy still increased by 17.8 per cent.[10]

2.2 The Potential for Renewable Energy in the MENA Region

The current situation means there is vast potential for the MENA region to increase its use of renewable energy, especially as it is extremely well-suited for the use of renewables, holding some 45 per cent of the total global potential for renewable energy.[11]

Of all renewable energy carriers, solar energy has the greatest potential in the MENA region. MENA solar energy alone would be sufficient to meet the world's electricity needs several dozen times over.[12] In the same vein, the region's annual economic electricity supply potential of solar energy was more than 72 times higher in 2005

Figure 2: Renewables Share in 2008 in Primary Energy Consumption of Various Regions



Source: Author's compilation based on IEA (2011e), Energy Balances of Non-OECD Countries, Paris: International Energy Agency.

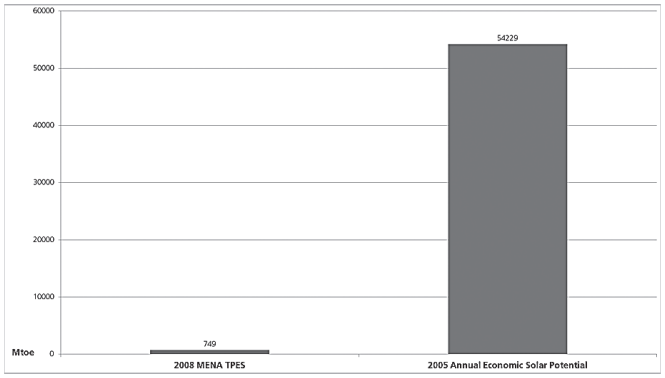
10. Author's calculation based on IEA 2011a and previous editions of this report; IEA 2011e and previous editions of this report.

11. El-Husseini et al. 2009, 5.

12. DLR 2005, 8.

than its 2008 total primary energy consumption (see figure 3). Many hours of sun and the large amounts of land available for the construction of solar panels provide ideal conditions for solar energy. As solar energy is available in two forms – concentrated solar power (CSP) and photovoltaic (PV) – it can meet »both distributed rural and centralised urban demand«.[13] CSP can be used for large-scale power supply, ideally integrated into a national or even regional grid. For small-scale remote areas with no access to a larger grid, PV is an attractive source of power.[14]

Figure 3: MENA Primary Energy Demand and Economic CSP Potential



Source: Author's compilation based on DLR (2005); IEA (2011a).

Wind, hydro, geothermal power, and biomass have significant potential, though it is rather modest as compared to the massive potential of solar energy. Combined, these four renewable sources have an annual economic supply potential of 65.5 Mtoe (million tonnes of oil equivalent), as of 2005.[15]

It is important to stress that the potentials discussed here are the annual *economic* electricity supply potentials, estimated in 2005. This means that it is expected for them to become cost-competitive vis-à-vis other energy carriers in the mid-term and long run as technology develops and economies of scale emerge.[16] This refutes often stated claims that renewables are generally economically unviable. In 2005, the *technical* potential – all renewable sources that could be developed using the existing technologies – was already higher than the economic potential.

13. Ibid., 9.

14. Ibid., 56.

15. Wind 20.4 Mtoe, geothermal 20.0 Mtoe, hydro 15.7 Mtoe, and biomass 9.5 Mtoe. See DLR 2005, 56.

16. Ibid., 55.

2.3 The Benefits of Using Renewable Energy

A renewable energy supply comes with a variety of benefits beyond the satisfaction of energy needs. On top of the environmental benefits, a renewable energy supply has long-term cost advantages. Furthermore, additional export earning can be generated through the export of both abundant renewable energy as well as fossil fuels that would otherwise be consumed domestically. Renewable energy can also increase energy-supply security, create a substantial number of jobs in the MENA region, and contribute to the electrification of rural areas.

- *Despite appearances to the contrary, renewables are the most economically viable sources of energy in the long term.* Looking at the (highly subsidised) consumer prices for energy in the MENA region, non-renewables appear cheaper than renewables. However, many costs associated with the use of non-renewables are not reflected by the consumer price. This is particularly the case for environmental costs of energy consumption. As discussed above, non-renewables contribute substantially to climate change, which is both economically and socially extremely costly for the MENA region.[17] The costs of adaptation measures to climate change are generally not reflected in the consumer price for energy and even less so in subsidised consumer prices. Nevertheless, these costs will make themselves felt: the greater the effects of climate change, the higher the costs of adaptation measures. Thus, from a long-term macroeconomic perspective, renewables have a clear cost advantage compared to non-renewables.[18] Even if environmental costs were disregarded, renewables would very likely achieve cost-advantages as compared to non-renewables, as there is an enormous potential for technology developments and the emergence of economies of scale, which will eventually reduce costs.[19]

- *With abundantly available supplies, MENA countries can export energy from renewable sources and thereby increase their incomes.* As discussed above, the economic potential in the region with solar energy alone is enormous and could provide for the region's own

17. See section 1.

18. If the environmental costs of energy consumption were reflected by the price of energy, non-renewables would become substantially more expensive, making renewables already today more cost-competitive. See section 4.1.

19. See section 4.1.

electricity and energy needs several dozen times over.[20] With Europe presenting itself as an attractive potential customer, this gives MENA countries the chance to export excess amounts of energy. Initiatives such as the DESERTEC or Medgrid projects point to the way. Even though they have yet to materialise, the prospects for renewables to both meet the region's energy needs and additionally generate export earnings are good. In order to meet 15 per cent of the European electricity demand in 2050, only less than 0.2 per cent of the area suitable for CSP installations in the MENA region would be required.[21]

■ *Renewable energy provides countries holding fossil fuels in abundance with the opportunity to free up fossil fuels for export*. The more that fossil-abundant states increase their domestic use of renewable energy, the lower the amount of fossil fuels they need for the satisfaction of their domestic energy demand. The fossil energy that is replaced in the domestic energy mix could be exported, thereby contributing to higher incomes from fossil fuel exports.[22] Especially for the Gulf States, this option is attractive, as it provides them with the manifold advantages of renewable energy, while at the same time increasing their income base from the increased export of fossil fuels. An analysis of the Iranian energy sector suggests that in 2050 up to 69 per cent of oil and 74 per cent of gas consumed domestically can be saved if sustainable energy is embraced.[23]

■ *Renewables can greatly advance energy security* – an aspect that is often undervalued in the debate dominated by environmental aspects. Energy-supply security is commonly defined as the access to reliable and affordable energy. Both aims can be advanced using renewable energy. On the one hand, renewables can help to reduce the variability of energy generation costs. The price of fossil fuels is influenced greatly by external factors and fluctuates accordingly. Renewable energy, to the contrary, has very stable and nominal productions costs. On the other hand, renewable energy can also help to reduce energy import-dependency. Using renewable energy, countries can control the energy supply chain to a very large extent. This obviously reduces their dependency on external factors that threaten the availability of supplies. As such, renewable energy can help to reduce the geopolitical risks commonly associated with energy-supply security. In particular, energy-scarce MENA countries can greatly increase their energy-supply security using renewable energy.[24]

■ *A large number of jobs can be created if the MENA region embraces renewable energy*. Despite the extraordinary importance of fossil fuels throughout the region, the fossil energy sector provides only very few jobs at a time when MENA countries are struggling with high unemployment rates. In the Gulf Cooperation Council (GCC), for example, the fossil energy sector accounts for 47 per cent of the GDP but employs only one per cent of the people. In stark contrast, the potential of the renewable energy sector for job-creation is high. It provides employment opportunities for both skilled and unskilled labour, ranging from research and development to manufacturing and assembly.[25] The solar energy sector alone has the potential to create several thousand jobs. A study on the job potential of CSP suggests that in the MENA region up to 79,000 jobs could be created in both construction and maintenance. As most elements along the supply chain can be constructed within the region, there is a very large potential for local firms.[26] The example of Germany illustrates this point. Whereas in 2004 some 160,000 people were employed by the German renewable energy industry, this figure more than doubled by 2010 to 367,000 jobs.[27]

■ *Renewable energy can also greatly contribute to the electrification of rural areas and thereby help to alleviate rural poverty*. For rural areas remotely situated from electricity grids, access to energy is a critical issue. Creating a connection to an established major grid is often economically unviable, as it might take decades to construct such a connection. Renewable energy can fill this gap and provide electricity even in areas remotely situated from large grids. »In even the most remote areas, renewable energy technologies such as household PV systems, micro-hydro-powered mini-grids, biomass-based systems, and solar pumps can provide sustainable energy services« a report notes. These range »from basic

20. See section 2.2.
21. O'Sullivan et al. 2011.
22. El-Husseini et al. 2009, 6-7.
23. Supersberger 2007, 74-76.
24. IEA 2007; Valentine 2011.
25. El-Husseini et al. 2009, 7.
26. Ernst & Young et al. 2011, 1-25.
27. BMU 2011a, 5-7.

necessities – including quality lighting, communications, and heating and cooling – to services such as motive powers that generate economic growth«.[28] Providing rural areas with electricity not only improves the livelihoods of its people by reducing the time required for household work or advancing health conditions (for example through the availability of clean – boiled – water). It also allows people in rural areas to engage in economic activity, thereby promoting rural development in general.[29]

Considering the great potential and manifold advantages of renewables, the question of why they are barely used in the MENA region should be addressed. The answer is to be found at the government level. There is apparently a lack of appropriate policies promoting the introduction of renewable energy in the MENA region. Indeed, as the International Energy Agency found, »government intervention is the main driver for the development of renewable energy«.[30] Against this backdrop, the following sections develop a policy proposal for the introduction of renewable energy in the MENA region. The paper considers both how the transition towards a renewable energy supply can be managed as well as the instruments conducive to the deployment of renewables. The proposals put forward are obviously very general and seek to address aspects relevant to the region in its entirety. They should therefore not be seen as a detailed concept but rather as stimuli for the debate.

3 Managing the Transition: Natural Gas As a Bridge

- **Natural gas appears as better suited than nuclear energy to accompany the deployment of renewables as a »bridge technology«.**

- **It seems advisable to reform the domestic gas-pricing schemes in order to avoid overconsumption and create incentives to develop upstream (exploration and production) capacities.**

- **The creation of win-win situations in joint projects with international energy companies is the key to achieving optimal outcomes in attracting foreign technologies and investments.**

It is obvious that the transition towards sustainable energy in the MENA region will take several decades, given that renewable energy only accounts for one per cent of its primary energy consumption (as of 2008).[31] In the meantime, non-renewable energy carriers must be used to accompany the deployment of renewables. Natural gas and nuclear energy are often discussed as bridge technologies, as their carbon emissions are relatively low compared to those of oil and coal. This section compares both energy carriers with regard to their ability to accompany the introduction of renewable energy in the MENA region. The comparison suggests that natural gas is better suited to this end than nuclear energy. In this sense, policies that could be adopted so as to facilitate the use of gas as the bridge technology are discussed in the latter part of this section.

3.1 Comparing Natural Gas and Nuclear Energy As Bridge Technologies

Drawing extensively from a study that compares the use of the two energy carriers as bridge technologies for Europe's transition towards renewable energy,[32] the following paragraphs compare the strengths and weaknesses of, first, nuclear energy and, second, natural gas to accompany the deployment of renewable energy in the MENA region (the order does not represent a hierarchy). Two factors stand out in favour of nuclear energy.

- The carbon balance of the entire nuclear energy cycle is better as compared to the natural gas cycle. Per kWh, nuclear power plants produce 5-33 grams of CO_2 emissions, while gas-powered plants emit 399-644 grams of CO_2. This, however, does not reflect the carbon emissions of heat generation, which is a critical issue, particularly in the eastern part of the MENA region, where winters can be hard. As nuclear power plants are only in very rare cases used for both electricity *and* heat generation, heat must commonly be generated additionally using fossil fuels. The difference in carbon emissions between nuclear energy and natural gas becomes marginal if the emissions of fossil fuel heat generation are taken into

28. REN21 2011, 65.

29. UNCTAD 2010, 6.

30. IEA 2010, 293.

31. Author's calculation based on IEA 2011a.

32. Viëtor 2011.

account, too. In order to produce one kWh of electricity and two kWh of thermal energy, nuclear power plants – combined with fossil fuels – emit 620-781 grams of CO_2 equivalent. Natural-gas-powered plants combined with gas- or oil-fired heating produce a little more, 798-897 grams of CO_2.[33]

■ The reserve-to-production ratio (r/p ratio)[34] of uranium is longer compared to natural gas. With roughly 100 years, the global r/p ratio of uranium is greater than that of the more or less 60 years of natural gas.[35] However, as the current level of consumption for any of the two energy carriers can rise or fall in the future, the r/p ratio is only a vague indicator and has limited practical application.

The following arguments support the use of natural gas as a bridge technology.

■ Natural gas is more economically viable than nuclear energy. It is true that the operating costs of nuclear energy are lower compared to those of natural gas and that nuclear energy is less affected by fuel price volatilities, as fuel costs only make up 20 per cent of a nuclear power plant's operating cost but some 70 per cent of natural gas power-plants. This, however, does not reflect the costs for the construction and disposal of power plants, costs that are considerably lower in the case of natural gas. The construction costs are particularly relevant to MENA countries, as both nuclear and gas-fired plants would need to be constructed in order to meet the region's rising energy demand. The investment costs for a natural gas plant are 800-900 EUR/kW but 2,000-3,500 EUR/kW in the case of nuclear plants.[36] In several nuclear plants built in OECD countries, prices ended up being well above 3,500 EUR/kW.[37] These costs are expected to increase, which will make nuclear energy even more expensive in the future. As the construction of nuclear power plants is enormously costly, energy prices would need to be extremely high in order for nuclear energy to be cost-effective. A 2009 analysis notes that the United Kingdom's nuclear power plants operated profitably in only 20 out of 115 months.[38] It is thus questionable whether in the MENA region, which has basically no experience with nuclear energy, it would ever be economically viable to use nuclear energy. With regard to the deconstruction, the disposal costs of natural gas plants are about the same as the construction costs.[39] But while the costs for the closure of a nuclear plant lie between 200 and 2,000 EUR/kW,[40] the costs for the disposal of nuclear waste are very high and difficult to estimate, with fluctuations of several billions euros for each and every nuclear power plant.[41] Further, the massive costs of a potential nuclear catastrophe are not included in the nuclear power plants' costs. One must therefore assume that a socialisation of these costs would happen in a disaster situation.[42]

■ In contrast to natural gas plants, nuclear power plants are poorly suitable to accompany the introduction of renewable energies to the grid. As solar and wind energy – the renewable sources with the greatest potential in the MENA region – are dependent upon the weather, the amount of power they provide varies. Thus, an energy supply that is mainly based on solar and wind requires a certain amount of other energy sources that can be flexibly introduced to the grid when solar and wind supply is low. In the long-term, non-volatile renewables like biomass can flexibly provide energy. In the short- and mid-term, though, the bridge technology would need to fulfil this role. The economic case for natural gas to assume this role is pressing. Throughout the MENA region, the use of nuclear energy would require the construction of new nuclear power plants. As the construction of these plants requires massive investments (see above), it would be necessary to operate them at full capacity as often as possible in order to amortise the high investment costs. This financial requirement of nuclear energy is a severe barrier to the kind of flexibility necessary for the introduction of renewable energy.[43]

■ Related to the high investment costs, the financial risks of nuclear power plants are substantially higher

33. Fritsche 2007, 9.

34. The reserve-to-production ratio represents the number of years in which a natural resource would be depleted if the current level of consumption were kept. It is a function of the amount of reserves divided by the current annual consumption.

35. Viëtor 2011, 35-37.

36. Prognos 2009, 2; Citigroup Global Markets 2009, 2.

37. MacKerron 2011, 6-7.

38. Citigroup Global Markets 2009, 2-3.

39. Viëtor 2011, 42.

40. Prognos 2009, 58.

41. Citigroup Global Markets 2009, 3.

42. Viëtor 2011, 41-44.

43. Ibid.: 31-34.

than those of natural-gas-powered plants. As discussed above, nuclear energy requires extremely high energy prices in order to be economically viable. The nuclear accidents at Three Mile Island, Chernobyl, and Fukushima show that »highly capital-intensive investment can be written off in a matter of hours« in addition to the subsequent costs of such accidents. This financial and economic risk of nuclear energy »hardly applies at all to alternative electricity generating options.« Evidence shows that private investors are unwilling to assume this risk, meaning that governments – and consequently the public – would need to take the financial risk of nuclear energy.[44]

- Whereas uranium reserves are spread across the world, 44.2 per cent of the world's natural gas reserves lie in the MENA region.[45] Thus, from a geographical perspective, access to natural gas does not constitute a problem.[46] Uranium is rather evenly distributed around the world and can be found in places as diverse as Australia, Canada, Kazakhstan, and Niger.[47] The import dependency of uranium is therefore significantly higher than in the case of natural gas.[48]

- Nuclear energy is unlikely to meet the region's rapidly growing energy demand. As discussed above, the MENA region is experiencing a massive increase in energy consumption. With lead times for the construction of nuclear power plants between 8 and 12 years (and often significantly longer),[49] it seems unrealistic that nuclear energy would be able to provide enough energy to satisfy the region's rising energy demand.

- Natural gas is more likely to create jobs in the region. For several decades, MENA countries have developed their natural gas industries and trained their people to become able engineers and workers. In the case of nuclear energy, »it is highly unlikely that a full-fledged nuclear industry will be established in the MENA region in due course«.[50] As a consequence, MENA countries would have to attract nuclear specialists from abroad while their own problems of unemployment would remain unresolved. Making things worse, there is an apparent lack of experts in the nuclear industry, which explains the massive delays in the development of nuclear projects around the world.[51] Likewise, in the absence of own experts, it seems questionable how nuclear energy projects can be implemented on a scale sufficient to meet the rising energy demand of the MENA region.

- Unlike nuclear energy, the operation of natural-gas-powered plants can be decentralised. A smaller decentralised local energy supply, in addition to larger central power plants, has important advantages. In close proximity to the consumers, local power plants reduce the distance over which electricity needs to be transmitted. This decreases both transport-related energy losses as well as the pressure on the electricity grid.[52]

- The effects of accidents along the natural gas chain are smaller compared to nuclear energy. While accidents in the course of natural-gas-use occur more often, nuclear energy has caused more deaths.[53] The damage caused by an ultimate MCA (maximum conceivable accident) of a nuclear power plant is impossible to estimate but obviously exceeds that of a natural-gas-related disaster by far.

- As opposed to natural gas, nuclear energy also involves severe risks of proliferation. These are particularly high in the conflict-laden MENA region. The human, environmental, and economic costs associated with a »dirty bomb« attack can hardly be overestimated and are also not reflected in the price for nuclear energy.

After comparing the respective strengths and weaknesses, it appears to the author of this paper that natural

44. MacKerron 2011, 6-7.

45. Author's calculation based on Cedigaz 2010, 10.

46. Jordanians might rightly raise security concerns as deliveries through the only pipeline supplying Jordan with gas (from Egypt, which is also delivering gas to Israel), was repeatedly attacked and flows interrupted. While in the long run the diversification of supplies is desirable (talks with Qatar are already under way), in the meantime the country could limit the effects of supply interruptions through the construction of gas storage facilities. If sufficient storage capacities are available, supply shortages can be overcome. In contrast to the high costs of nuclear energy, gas storage would be a considerably cheaper means for the enhancement of the Jordanian supply security.

47. Viëtor 2011, 19.

48. Again, Jordan might appear as an exception to this. But even though Jordan possesses own uranium reserves, this would not reduce the country's dependency on third parties if nuclear were to be used. The uranium reserves would obviously reduce Jordan's fuel-import dependency. At same time, however, it would become dependent on companies from other countries for mastering the other steps of the fuel cycle. In Europe, for example, France is the only country that independently masters the entire cycle. See Viëtor 2010.

49. Kumetat & Supersberger 2010.

50. Ibid.

51. Mez 2011, 18.

52. Viëtor 2011, 34

53. Ibid., 38-41.

Table 1: Natural Gas and Nuclear Energy as Bridge Technologies

Arguments for nuclear energy as the bridge technology
■ The carbon balance of nuclear energy is better than that of natural gas.
■ The r/p ratio of uranium is longer compared to that of natural gas.
Arguments for natural gas as the bridge technology
■ Overall, natural gas is more economically viable than nuclear energy.
■ From a commercial perspective, newly built nuclear power plants lack the flexibility to accompany the introduction of renewable energy carriers to the grids.
■ In contrast to natural gas, the financial risks of nuclear power are too high for private investors, meaning that governments must step in and guarantee the risks.
■ Vast natural gas fields lie within the MENA region, ensuring easy access from a geographical point of view.
■ As a single nuclear power plant requires a minimum of 8 to 12 years of construction time, nuclear energy is unlikely to be able to meet the region's rapidly increasing energy needs.
■ Based on decades-long experience, the natural gas industry can create more jobs in the MENA region, whereas nuclear experts would have to be recruited from abroad.
■ In contrast to nuclear plants, the operation of natural-gas-powered plants can be decentralised, relieving pressure on electricity grids and reducing electricity losses.
■ While natural gas accidents occur more often, the damage of a nuclear catastrophe is far more disastrous.
■ Natural gas does not involve any proliferation risks.

gas is better suited to function as a bridge technology for the introduction of renewable energy in the MENA region. As would be the case with any other energy carrier, too, this comes with several policy challenges for decision-makers in the region.

3.2 Policy Challenges for the Use of Natural Gas As a Bridge Technology

The prospects for natural gas to accompany the transition towards a sustainable energy supply in the MENA region as a bridge fuel are generally positive. In 2010, the MENA region held some 44 per cent of the world's proven natural gas reserves but only accounted for 14.3 per cent and 22.6 per cent of the worldwide natural gas consumption and production in 2009. Remarkably, 75 per cent of the marketed production was consumed inside the region.[54] This reflects both an underdevelopment of the region's upstream (exploration and production) sector as well as a massive overconsumption due to artificially low gas prices. Nevertheless, in terms of reserves, there is sufficient gas available over the next decades for natural gas to accompany the introduction of renewable energies. Nine MENA countries have natural gas reserves of more than 1,000 bcm. Only Oman, Yemen, Syria, Bahrain, Israel, Tunisia, and Jordan are gas-short. These seven gas-short countries, however, are all neighbouring gas-rich countries, so that from a geographical perspective, also these countries have relatively easy access to larger natural gas reserves.

The domestic use of natural gas has already been embraced by a number of MENA countries. In the decade from 1999 to 2008, natural gas demand grew by some 80 per cent in the MENA region, while the overall energy consumption grew by 66 per cent. Interestingly, most gas-short MENA countries not only increased their natural-gas-use in absolute terms but also the share of natural gas in their respective energy mixes. Among the gas-rich countries, the picture is diverse. The share of natural gas in the energy mix increased in Egypt and Iran, remained roughly at the same level in Libya and Qatar, and decreased in Algeria, Iraq, Kuwait, Saudi Arabia, and the United Arab Emirates. Overall, the share of natural gas in the MENA energy mix increased by 3.6 per cent, from 42.6 to 46.2 per cent.[55] While each and every country has an individual set of motives, there are some general factors explaining the move to increase the domestic use of natural gas. From a technical point of view, it is significantly easier to export oil than gas and the latter's exports involve higher risks than the former's. Therefore, many countries prefer to use gas domestically in order to free oil for exports. At the same time, there is an environmental argument for the domestic use of natural gas, as its use is considerably cleaner than that of oil or coal. Of all non-renewables, natural-gas-powered plants provide an economically and environmentally attractive way to meet the massively increasing energy demand in the MENA region. For oil-rich countries, natural gas is a means to reduce their economies' dependence on

54. Author's calculation based on Cedigaz 2010, 10, 43-45, 155-156.

55. Author's calculation based on IEA 2011a and previous editions of this report.

oil, and for energy-short countries, gas is an attractive alternative to diversify their energy mix away from oil.

The critical issues for the further increase in MENA natural-gas-use are political tensions within and among MENA countries as well as gas pricing and related questions of consumption and upstream development. Contrary to what might be expected, the region's political tensions have barely affected the MENA's natural gas sector so far. The political situation in the MENA region today can hardly be described as stable. In addition to the Israeli-Palestinian conflict, post-war Iraq and Libya, and the tensions surrounding Iran's nuclear programme, the Arab Spring in Bahrain, Egypt, Saudi Arabia, Syria, Tunisia, and Yemen is – while rightly appreciated – nevertheless destabilising the region, at least in the short-run. Interestingly, with the exception of Libya, gas trade remained remarkably stable. The Egyptian-Israeli/-Jordanian as well as the Iranian-Turkish pipelines have been attacked several times. But despite short interruptions, trade through these pipelines was never halted for a long period.[56] Analysts therefore conclude that the effect of the Arab Spring will make itself felt in the long run. Governments more responsive to their people are less likely to reform the region's heavily subsidised pricing schemes. At the same time, they might try to maximise their energy incomes by worsening the contractual terms for international energy companies, which would negatively affect the development of upstream capacities. Further, in order to create jobs, MENA governments might be inclined to promote energy-intensive industries domestically at the expense of natural gas exports.[57] Nevertheless, until now the impact of political tensions on the performance of the gas industry in the MENA region has only been modest.

Rather, the pricing of natural gas is the critical issue. Domestic gas prices in the MENA region are among the lowest in the world. Subsidising governments commonly argue that energy subsidies help to alleviate poverty and to promote the development of their economies. While these goals are very often not achieved, energy subsidies cause several negative effects. As the International Energy Agency highlights, subsidies encourage the overconsumption of energy, hasten the decline of exports, threaten energy security by increasing imports, drain state budgets for importers, discourage investment in energy infrastructure, distort markets and create barriers to clean energy investment, increase CO_2 emissions and exacerbate local pollution, dampen global-demand responsiveness to high prices, encourage fuel adulteration and smuggling, and they disproportionally benefit the middle class and rich.[58]

Two negative effects stand out with regard to the use of natural gas as a fuel bridge for the introduction of a renewable energy supply. On the one hand, subsidies are encouraging the overconsumption of natural gas, which is reflected in the region's poor energy productivity (see above). On the other, it is discouraging investment in – and thereby the development of – upstream capacities, as gas prices are only marginally above or even below production costs. Both national as well as international energy companies are reluctant to invest in the development of natural gas projects if these are economically unviable. The case of flared gas illustrates this. In many cases, gas associated with oil fields is produced during the exploitation of the oil fields. Under current prices, the recovery of this gas is often unprofitable, meaning that the associated gas is simply flared. In 2009, MENA countries on average flared almost five per cent of their gross natural gas production, which amounts to some 40 bcm. This is more that the respective gas consumption of Algeria, Bahrain, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Morocco, Oman, Qatar, and Syria. Countries like Iran (8.5 per cent), Libya (11.1 per cent), or Iraq (42.1 per cent) even flared substantially higher rates of their production.[59] As this discussion shows, the current pricing schemes result in a serious dilemma, in which a gap between a massive growth in demand is facing very strained and limited leeway to increase supply.[60] In the worst case, demand would outstrip supply, leading to actual gas shortages. This can be avoided by reforming the MENA region's domestic pricing schemes.

For gas-short countries, the artificial pricing schemes constitute a further problem. While gas-rich countries might forgo additional export earnings if gas is over-

56. While lasting only rather short periods, the supply interruptions were nevertheless extremely costly. In Jordan, for example, they cost a total of 2.5 billion US dollars in 2011, as the country had to import additional quantities of oil. This illustrates the importance of (gas) storage capacities that are able to bridge periods of low or fully interrupted supplies. See above.

57. Darbouche & Fattouh 2011, 34-39.

58. IEA 2011f.

59. Author's calculation based on Cedigaz 2010, 43, 156.

60. Fattouh & Stern 2011a, 5-7.

consumed domestically, gas-short countries must pay on top. Today, natural gas trade by ship using liquefied natural gas is becoming increasingly competitive vis-à-vis pipeline trade. This means that the number of customers available to exporting countries is growing. So even though the gas-short MENA countries are in geographical proximity to large gas reserves, access is increasingly regulated through prices. MENA exporters do not altruistically sacrifice higher export earnings for the sake of regional gas trade. The International Gas Union assumes that future intra-regional gas trade will be »at international market prices«.[61] This trend is increasing the costs of subsidised gas prices and thereby creates an additional incentive for gas-short MENA countries to reform their domestic pricing schemes by cutting subsidies in order to be able to compete with global demand.

This discussion shows that in light of the negative effects of subsidised energy, there is an urgent need for both gas-rich and gas-short countries to address the issue of pricing in order to avoid gas shortages. Generally, the abovementioned negative effects of fossil fuel subsidies are acknowledged. However, as in the short-term reforms would cast a substantial burden upon their populations, many governments are hesitant to reform the pricing schemes. In some countries, like Egypt or Iran, reforms of the subsidy schemes are already under way.[62] But while it remains uncertain whether the reforms will be implemented as planned, most MENA countries showed no intention of changing their domestic pricing of fossil energy thus far. So despite reform ambitions in some countries, the MENA region is overall very far from a marked-based pricing scheme. As this is endangering the availability of sufficient supplies in the mid- and long term, there is an urgent need for MENA countries to reform the pricing of energy.

Beyond pricing, relations between energy-rich states and their national energy companies on the one hand as well as international energy companies on the other have been a much contended issue in recent years. In the MENA region, natural gas reserves are under the control of the governments, whose national energy companies (NECs) are running the industry on their behalf. Often, NECs have several structural weaknesses in areas where international energy companies (IECs) are typically strong. In the challenge to ensure the development of their upstream capacities, NECs could greatly benefit from the expertise of IECs with regard to issues like strategic thinking, human resources, as well as investments in research and development.[63] On the other hand, IECs could enjoy access to energy reserves that NECs can provide them with. Generally, cooperation has the potential to benefit both sides and is therefore sought by both NECs and IECs. The central issue determining the relations between NECs and IECs are the contractual terms. When negotiating the contractual terms, MENA countries are well advised not to limit themselves to monetary profits but to consider the long-term development of their fields and industries. Attracting sufficient investments and technology is key here.

Relatively unfavourable contractual terms do not generally prevent cooperation but fail to achieve optimal outcomes. Several MENA countries experienced failure in securing investment and technology because they failed to appreciate the NECs' commercial needs. The case of Iran is certainly extreme, as the Islamic Republic completely forbids foreign ownership in the energy sector and thereby reduces the role of IECs to that of service contractors. But also countries like Algeria and Iraq have at times witnessed difficulties in attracting IECs. When Algeria worsened the terms of investment in 2007/2008, IECs were repelled, which significantly slowed down the development of Algeria's gas fields.[64] Qatar, on the contrary, was able to establish herself as a key player in global natural gas in only little more than a decade. The key to Qatar's success was the active embrace of international companies whose expertise allowed the tiny country with no industrial history to rapidly develop its natural gas infrastructure.[65] While a detailed analysis of the respective circumstances is beyond the scope of this paper, the centrality of fruitful cooperation between NECs and IECs should nevertheless be highlighted here.

As the availability of sufficient gas supplies rests on the future development of the MENA countries' upstream sectors, relations with international energy companies ought to be shaped in a way that is conducive to attracting foreign technologies and investments. If natural gas is to be used as the bridge fuel to accompany the intro-

61. IGU 2011, 57.

62. IEA 2010, 588-591.

63. Marcel 2011.

64. Darbouche 2011, 20-24.

65. Flower 2011, 343-385.

duction of renewable energies in the MENA region, adequate gas supplies must be available. The availability of sufficient gas depends on the ability of MENA countries to ensure the development of their upstream capacities. Here, cooperation among NECs and IECs is necessary. Only NEC-IEC cooperation can provide the investments and technology-transfers necessary for the maintenance and development of the MENA region's gas fields and infrastructure. To this end, MENA countries should focus on creating win-win situations in negotiations with international companies.

This section discussed how the transition towards a renewable energy supply in the MENA region could be managed. As today only one per cent of the MENA region's energy supply stems from renewable sources,[66] a »bridge fuel« must be used for the transition towards an energy supply that relies fully on renewable sources. For a variety of reasons, natural gas appears to be better suited to accompany the introduction of renewable energies in the MENA region. The increased use of natural gas, however, requires the availability of sufficient supplies. For this reason, MENA countries are well advised to reform their domestic pricing schemes in order to end overconsumption and create incentives to develop upstream capacities. Similarly, MENA countries can benefit from creating win-win situations in negotiations with IECs so as to attract investments and technologies.

4 Introducing Renewables: Getting the Policies Right

- **As they pose a direct barrier to the deployment of renewables, it is highly advisable to phase out fossil fuel subsidies.**

- **Until fully competitive in the markets, renewable energy requires some form of subsidisation.**

- **A broad variety of policy instruments are available for the subsidisation of renewable energy.**

- **The best-suited policy instrument ought to be chosen based on each country's particular circumstances with regard to effectiveness, appeal to investors, and efficiency.**

66. Author's calculation based on IEA 2011a.

- **All-encompassing national energy strategies – implemented by national authorities with all competences and means necessary – promise the greatest success.**

- **In addition to inter-regional cooperation, intra-regional cooperation allows for the valuable sharing of experiences among MENA countries.**

4.1 Subsidising Energy: Replacing Fossils Fuels with Renewables

Similar to the global trend, the deployment of renewables in the MENA region requires some form of government intervention. Around the world, renewables are in many cases not yet cost-competitive in the markets. Until the market drivers for renewable energy are fully developed, governments are asked to facilitate the introduction of renewable energy.[67] Considering the long-term benefits of renewable energy as opposed to fossil fuels, many governments adopt measures promoting the deployment of renewable energy carriers. Essentially, the existing markets for renewable energy today were all created through political measures.[68] Worldwide, subsidies for renewable energy are expected to increase from 66 billion US dollars in 2010 up to some 250 billion US dollars in 2035.[69]

The deployment of renewable energy carriers can be promoted in manifold ways. A very effective and desirable way would be the introduction of an energy-pricing scheme that reflects *all costs* related to the production and use of each energy carrier. Such a pricing scheme would internalise all or most externalities of a given energy carrier's use. The price for energy would then also reflect the environmental costs of fossil fuel and nuclear energy production and consumption and thereby greatly advance the cost-competitiveness of renewable energy. A study shows that if all externalities were internalised into the price of energy, electricity prices for oil and coal in the European Union would double.[70] However, it appears that the political obstacles to the introduction of a global scheme internalising all costs of an energy carrier's use are too high to be overcome anytime soon.

67. Hamilton 2011, 12.

68. Fischedick & Hennicke 2010, 71.

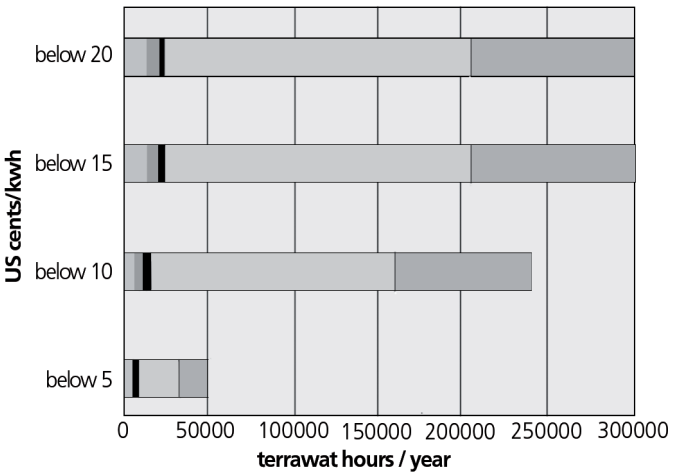
69. IEA 2010, 530.

70. See Schafer et al. 2007, 83.

In light of these circumstances, subsidies for renewables appear as the best-suited instrument to promote the introduction of renewables. Subsidies for renewable energy are aimed at reducing the consumer price for renewable energy so as to make them economically competitive. The intention is usually to facilitate both the deployment of renewables and the improvement of research and development. Thereby, the costs of renewable energy are expected to decrease over time, making renewables increasingly cost competitive. In contrast to fossil fuels and nuclear energy, there is still a massive potential for cost reductions in the renewable energy industry. As the industry has just started to develop, the potentials for learning effects, technology leaps, and mass production have yet to be exploited. If these potentials are realised, renewables will not only be the most environmentally friendly energy sources but also the most economically viable.[71] Subsidies for renewable energy are a means to facilitating the realisation of these potentials in order make renewables economically competitive vis-à-vis fossil fuel. At the end of this process, the need for subsidisation ceases. Subsidies for renewable energy are therefore *finite* subsidies, which should no longer be used once their purpose is fulfilled.[72] At the same time, the effect of subsidies for renewables is overall positive, as they help to increase the share of clean energy and promote the many other advantages that come with renewable energy.

In stark contrast to subsidies for renewables, fossil fuel subsidies have overall negative effects and pose a severe barrier to the deployment of renewable energy. Fossil fuel subsidies comprised more than 86 per cent – totalling 409 billion US dollars – of global energy subsidies in 2010. The rationale behind the subsidisation of fossil fuels commonly has a social or political rather than an economic nature. A typical reason is the creation or preservation of jobs in energy-intensive industries by creating a cost-advantage for these industries. However, despite such good intentions, fossil fuel subsidies have been shown to be »an unsuccessful or inefficient means«, as the International Energy Agency observed.[73] As discussed above, fossil fuel subsidies have many unintended negative effects, including the encouragement of energy overconsumption, the draining of state budgets, or the disproportional privileging of the middle and upper classes.[74] The example of Iran illustrates this. Before the reforms initiated in late 2010, subsidies cost the Iranian state 60 to 100 billion US dollars annually.[75] Worse, despite holding the world's second largest reserves, Iran was a net importer of natural gas for most of the past decade. At the same time, the role of renewables in Iran is almost negligible. By keeping the prices for fossil fuels artificially low, fossil fuel subsidies pose a significant barrier to the introduction of renewable energy. Moreover, unlike renewable energy subsidies, fossil fuel subsidies are *infinite*, as their aim is not to assist the market introduction of a respective energy carrier but to ensure permanent cheap access to it. Fossil fuel subsidies therefore pose a direct obstacle to the introduction of renewable energies. Figure 4 shows the barrier posed to the deployment of renewables by artificially low fossil energy prices.

Figure 4: Potentials for Renewable Power Generation in Africa and the Middle East



This figure shows the amount of electricity that renewable energy could provide each year as a function of the energy price.
Source: REN21 2008, 8.

For these reasons, removing fossil fuel subsidies is important for promoting renewable energy in the MENA region. Considering the economic obstacle for renewable energy deployment as well as the many other negative effects of fossil fuel subsidies, there is a strong case

71. Fischedick & Hennicke 2010, 85-86.

72. See IEA 2011b, 527-540.

73. IEA 2011b, 508-510.

74. See section 3.2.

75. *The Economist*, 23 June 2011.

for their removal. At the same time, it is clear that subsidies cannot be fully removed from one day to the next. This, however, ought not result in the endless continuation of fossil fuel subsidies. Rather, a timeframe of a decade or so might generally appear as appropriate for their phase-out. An ambitious plan put forward by the Iranian government even aims at the removal of most subsidies within five years.[76] While obviously extremely painful for the populations in the short-run, removing fossil fuel subsidies provides the people with greater benefits in the long term. For the transition period, targeted assistance to those in need can help to overcome the negative effects of subsidy cuts. The removal of fossil fuel subsidies would not only increase the prices of fossil energy and thereby increase the cost competitiveness of renewables. The money saved by such a move – several dozen if not hundred billions in US dollars just in the MENA region – could be used for the subsidisation of renewables as well as other measures advancing development for the people.

4.2 Instruments to Subsidise Renewable Energy

There are a variety of instruments through which renewable energy can be subsidised. Around the world, different types of subsidies are used to promote the introduction of renewable energy. Countries in the MENA region are very heterogeneous with »differences in energy resources, drivers, technologies and existing market conditions and energy policy development«.[77] For the foreseeable future, these differences are unlikely to be overcome, therefore each MENA country must in the meantime decide for itself which instrument(s) is (or are) best suited for its particular circumstances. The following overview introduces several key instruments for the subsidisation of renewable energy.

- *Price-based subsidisation: the feed-in tariff (FIT).* FITs are generally characterised by guaranteed access to electricity grids for renewable energy carriers and the guaranteed long-term demand at a price reflecting both the costs of production and a specified return for the producer. Commonly, utility companies and grid operators are forced under a FIT to buy electricity from renewable sources at a defined price from the producers of renewable energy. In order to avoid that, individual companies (and ultimately the consumers) must bear the additional costs – the difference between renewable energy and market prices are in many cases distributed evenly among all producers and thus consumers. Depending on its configuration, the FIT scheme can be used generally to both subsidise all renewable energy sources by applying one fixed price or to promote specific carriers in particular need of support. FITs constitute the most common renewable energy subsidy and are used by 61 countries and 26 federal states/provinces around the world.[78] The German FIT is often used as a role model for the introduction of FITs in other countries and has proved to be successful in deploying renewable energy in Germany (see Fact Box).

- *Quantity-based subsidisation: the tradable green certificate scheme (TGC, also known by its US name »renewable portfolio standard« or RPS).* Using a TGC, electricity providers are forced to supply a certain amount of electricity with energy from renewable sources. Electricity companies can meet their obligations under a TGC by creating renewable energy through the ownership of a renewable energy facility, the acquisition of certificates of renewable energy production from other energy companies, or the purchase of renewable energy from a third company. Thereby, energy companies engage in two markets: the conventional electricity market and the market for certificates. The TGC scheme requires the permanent monitoring of all actors in the energy sector with regard to the meeting of their obligations. Ideally, this is done through an institution with the mandate to impose appropriate fines on offenders. In contrast to the FIT, the TGC can ensure that a defined share of the energy mix is supplied with renewable energy, as quotas can easily be defined accordingly. As with the FIT, quotas can be defined either for particular energy carriers or generally for all renewables. Using an overall quota for all renewable sources will increase competition among the various renewable carriers and thereby provide a greater stimulus for technology improvements and cost reductions.[79]

- *Creating tax incentives.* Tax reductions can promote the introduction of renewable energy in manifold ways.

76. On the Iranian subsidy reform, see Guillaume et al. 2011.

77. Hamilton 2011, 17.

78. Held 2007, 13; REN21 2011, 55-57.

79. Held 2007, 14; U.S. Environmental Protection Agency 2009.

For producers of renewable energy, they can effectively increase a company's after-tax earnings. For energy consumers, they can reduce the cost of energy consumption, leading them to choose renewables over fossil fuels. Tax incentives can also help to stimulate the development of a local manufacturing capacity. There are different tax incentives that can assist the introduction of renewable energy. These include *investment tax incentives*, *production tax incentives*, *property tax reductions*, *value-added tax reductions*, *excise (sales) tax reductions*, *import duty reductions*, *accelerated depreciation*, *research, development, demonstration and equipment manufacturing tax incentives*, *tax holidays*, and *taxes on conventional fuels*. The broad variety of instruments allows for an extremely flexible application of tax incentives according to the respective local needs.[80]

■ *Further instruments to subsidise energy.* In addition to the instruments discussed above, there are further ways to subsidise the introduction of renewable energy. These include the imposition of trade barriers for non-renewable energy (such as higher tariffs), easier access to capital by preferential credit conditions for producers of renewable energy, or capital payments on renewable energy investments.[81]

It is impossible to suggest that one of the instruments discussed above is »the best« in promoting the introduction of renewable energy. Rather, the best-suited instrument ought to be chosen in each case individually after reviewing the geographical conditions and the hitherto development of the respective energy markets, including the political circumstances. There are generally three main criteria on which any such review should be based. *Effectiveness*: Is the respective instrument actually promoting the deployment of renewable energy, and if so, to which extent? There are several ways to assess this but the best seems to be a comparison of the absolute renewable energy growth in relation to the potential for deployment. *Appeal to investors*: renewable energy has a higher risk than fossil fuels due to uncertainties with regard to the evolution of demand and prices as well as the early stage of its technological development. Instruments fulfil their purpose of promoting renewables if they increase the profitability of renewable energy investments while at the same time reducing their risks as much as possible. *Efficiency*: apart from effectiveness and appeal to investors, policy instruments for the promotion of renewable energy must obviously be affordable. The question here is whether the costs of a given policy instrument are in reasonable relation to their effect.[82] An assessment considering these and possibly also further factors will reveal the most appropriate policy instrument for each country.

Around the world, FITs and TGCs are the most widely used subsidy instruments for the promotion of renewable energy. Theoretically, the TGC is expected to deliver better outcomes than the FIT. Under a FIT, there is very little competition between renewable energy producers, as the return on renewable energy is guaranteed irrespective of the demand situation in the market. Equally, meeting renewable energy targets is rather coincidental, as governments can hardly set the return at a price necessary for reaching a particular goal, considering price fluctuations on the energy and electricity markets. Using a TGC, clearly defined renewable energy goals can be met by defining the quota correspondingly. A further advantage of the TGC is the competitive market conditions they can create for renewables. Electricity from renewable energy has to be sold at market prices and under market conditions (including the trade of certificates). Unlike under a FIT scheme, the producer must bear the full price risk under a TGC. This forces renewable energy producers to continuously reduce the costs of renewable energy by improving its production. The FIT, though, is only creating a long-term incentive for production-cost reductions (when the FIT's fixed returns are reduced and eventually expire). Consequently, the quantity-based TGC scheme gives governments greater control over prices than FITs. Despite the theoretical advantages of the TGC over the FIT, however, it is not possible to prove empirically that the TGC scheme is more successful in promoting the deployment of renewables. Success depends rather on stable overall conditions for investors.[83] Generally »it is […] less important which form of incentive is used,« as a discussion with renewable energy-investors revealed, »but that it is stable, long term, that it is designed for the characteristics of renewable energy (and sub-sectors), and that any reviews are done in a fully transparent, predictable manner«.[84] The

80. Clement et al. 2005.

81. Schafer et al. 2007, 85.

82. Held 2007, 19-26.

83. Institut der deutschen Wirtschaft Köln 2011.

84. Hamilton 2011, 16.

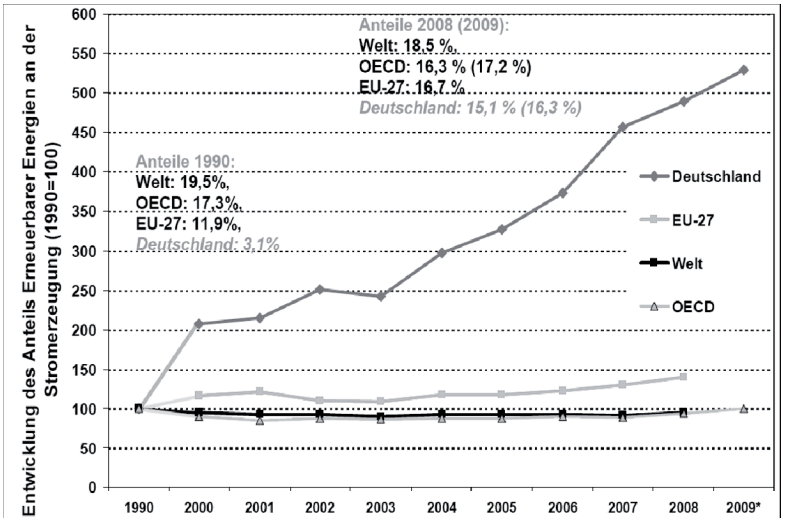
Fact Box: The Renewable Energy Act (EEG) – Germany's Feed-In Tariff

In 2000, the Renewable Energy Act (Erneuerbare-Energien-Gesetz, EEG) introduced a comprehensive FIT system in Germany. The EEG proved to be very successful in deploying renewable energy and is therefore considered as a role model by many around the world. Thanks to the EEG, within only a decade Germany was able to increase the renewable-energy share in the primary energy mix from 6.4 per cent in 2000 to 16.8 per cent in 2010. By 2020, Germany plans to meet 35 per cent of the primary energy mix from renewable sources, 50 per cent by 2030, and 80 per cent by 2050. Current estimates expect Germany to surpass these targets and to reach a renewables-share in the primary energy mix of 38.6 per cent by 2020.[1] Beyond the energy supply itself, the EEG created several hundred thousand jobs in Germany and some 367,000 people were employed by the German renewable energy industry in 2010.[2]

The German EEG comprises three key elements: *first*, the guaranteed grid access for renewable energy producers, including the extension of the grid to this end where needed; *second*, the preferred feed-in of renewable energy into the power grid; *third*, a long-term (commonly 20 years), fixed, economically viable price for renewable energy, the additional costs of which – compared to the market price for energy – are shared among all energy producers/consumers.[3]

The great success of the EEG can be explained with a variety of factors. On the technical side, a broad variety of renewable sources exist in abundance in Germany and the technologies necessary for their development are readily available. Because of their environmental friendliness, renewable energy carriers enjoy broad approval throughout German society. Further, the EEG is embedded in an effective institutional framework, which greatly contributes to its success: as a federal law, it applies to the whole of Germany, and by encompassing the whole range of renewable energy technologies, it establishes roots in all parts of society. With long-term targets and guarantees, the EEG provides investors with the much-wanted security for their investments. The success of the EEG is also closely related to the competences it gives to the Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU). The law increased the BMU's mandate and capacity so that it enjoys all means necessary for monitoring and further developing the EEG. Politically, the EEG was facilitated by a change in the federal government in 1998. The coalition of Social Democrats and Greens, which then took office, consisted of many renewable energy supporters. Once in power, they facilitated the EEG.[4]

Figure 5: Increase in Electricity Generation from Renewable Energy in Germany



This figure shows the development of the renewables-share in electricity generation compared to 1990 (1990 = 100) in Germany (Deutschland), the EU-27, the world (Welt), and OECD countries. Source: BMU 2011b, 4.

1. BMU 2011b.
2 . BMU 2011a, 5 7
3 . BMU 2011b.
4. Hirschl 2007, 558 565.

FIT's guaranteed demand and return is taking the price risk from the producer, giving him security and thus an incentive to produce renewable energy. For these or other reasons, around the world governments tend to favour the FIT over the TGC. In the past five years, 44 FITs were introduced but only 15 TGC schemes.[85]

4.3 Establishing National Authorities and Strategies

In light of the manifold structural differences between countries in the MENA region, it appears that the best way to promote the deployment of renewable energy is to focus on the national level. Here, the introduction of renewables can best be promoted by designing national energy strategies, the implementation of which would be observed by national authorities with all the necessary responsibilities and competences for this task. The goal of this endeavour is to shape policies in a way that makes it rational for both producers and consumers to embrace renewable energy.

If renewable energy deployment policies are expected to be successful, it is important that they do not conflict with other (energy) policies. As discussed above, the promotion of renewable energy does not so much depend on a particular policy instrument but rather on the stability and predictability of the instrument chosen. It is therefore important to integrate any renewable energy policy into a broader national energy policy.[86] A national authority responsible for coordinating all energy affairs is certainly the most effective way to ensure a coherent overall policy design.

Most countries in the region have already adopted renewable energy targets, but generally these goals are not being sufficiently supported by appropriate strategies and agencies. Almost all countries in the region have some form of renewable energy targets. Algeria, for example, is planning to meet six per cent of its primary energy mix by 2015 with renewables; Egypt is striving to supply 12 per cent of its mix with renewable energy by 2020. But throughout the region, there are effectively no strategies in place helping to achieve such laudable targets. A report notes that »Most countries have no adequate legal framework for the support of renewable energy and negotiate each case as it comes«.[87] However, the deployment of renewable energy in the MENA region (as elsewhere, too) needs to be supported with consistent and coherent strategies. The implementation of such strategies through binding laws can provide the security and stability sought by investors in renewable energy.

A national authority with all responsibilities and competences needed for ensuring the implementation of the (renewable) energy strategy appears to be the best way to ensure the deployment of renewable energy. In some countries like Egypt and Libya, national authorities have already been established and operate with well-defined duties and powers. In most MENA countries, however, national authorities are rather ineffective or do not exist at all. The problems include a lack of coordination between various national actors engaged in renewable energy policy and – where authorities exist – a lack of a clear mandate defining responsibilities and competences.[88] The establishment of capable national renewable energy authorities, however, is key for the execution of renewable energy strategies, and thus the deployment of renewables.

Beyond the national level, cooperation with partners from both inside and outside the region can greatly advance the introduction of renewable energy. As most MENA countries – perhaps with the exception of Tunisia – are rather inexperienced with regard to the deployment of renewables, they can greatly benefit from sharing their experiences. This includes all aspects related to the introduction of renewable energy, ranging from the design of policies to the creation of a local manufacturing capacity. Obviously, any such intra-regional cooperation cannot be expected to take place at the expense of cooperation with countries that already have extensive experience with renewable energy. The knowledge of these countries obviously offers valuable sources of advice for all countries beginning to use renewable energy. However, fostering intra-regional cooperation in addition to this is all-too-often overlooked.

With regard to the actual design of policies, one possible way would be to start on a project basis. The exam-

85. Institut der deutschen Wirtschaft Köln 2011.

86. Hamilton 2011, 16.

87. MVV decon & Wuppertal Institut 2010, 39.

88. Ibid., 40-41.

ple of the GCC states shows that (rather small) projects outside the established bureaucratic structures promise great success.[89] Ultimately, however, the transition of the MENA region's energy supply to renewables requires a broad and comprehensive policy effort.

5 Conclusion – Renewable Energy in the Middle East and North Africa: Wishful Thinking?

This paper seeks to present policies for a renewable energy supply in the Middle East and North Africa. Enjoying the world's greatest potential for renewable energy, the region can benefit greatly from a transition towards renewable energy. One of the central arguments presented is that renewables are not only the most environmentally friendly energy sources but in the long-term also the most economically viable. Considering this and the manifold other benefits of renewable energy – ranging from job creation to increased energy security – there is a very strong case for a renewable energy supply in the region.

The marginal role that renewable energy is assuming today in the region can not only be explained by the relative novelty of the respective technologies. Rather, in light of the prominence and dominance of fossil fuels, there is apparently a lack of appropriate policies facilitating the introduction of renewables. In order to provide policymakers and the interested public with some stimuli for thought, this paper sets out to discuss policy ideas for the transition towards a renewable energy supply. The electricity sector is the focus of the paper's analysis. The paper suggests that for both environmental and economic reasons natural gas is the best-suited non-renewable energy carrier to accompany the introduction of renewables as a »bridge technology«. At the same time, several policy instruments for the promotion of renewable energy were presented. If MENA countries use any of these instruments as part of all-encompassing, long-term, and effectively enforced national energy strategies, the prospects for renewable energy in the region are more than bright.

So, is a renewable energy supply in the Middle East and North Africa wishful thinking? Considering the almost complete absence of renewables from the regional energy supply today, the answer must be yes. However, *this wish is anything but unrealistic*. There is every likelihood that the Middle East and North Africa will be able to enjoy the manifold blessings of a renewable energy supply, if courageous action is undertaken at the political level.

89. Hertog & Luciani 2009, 28-29.

List of Acronyms

BCM billion cubic meters

BMU Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (Bundesministerium für Umwelt, Naturschutz und Reaktorsicherheit)

CSP concentrated solar power

EEG German Renewable Energy Act (Erneuerbare Energien Gesetz)

FIT feed-in tariff

GCC Gulf Cooperation Council/Cooperation Council for the Arab States of the Gulf

IEC international energy company

MENA Middle East and North Africa

Mtoe million tonnes of oil equivalent

NEC national energy company

OECD Organisation for Economic Co-operation and Development

PV photovoltaic

TGC tradable green certificate scheme

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This study was commissioned by the FES Sustainable Energy Programme in the MENA region. The programme supports the search for suitable policies to promote energy savings and energy efficiency. Moreover, it encourages a transition towards an energy supply based on renewable energy sources. While the Middle East and North Africa hold a greater potential for the use of renewable energy than any other region on the planet, it is at the same time the region with the smallest share of renewable energy in its primary energy supply. Many analysts see the way energy policies are structured in most MENA countries as the main reason for the lack of renewable energy utilities and the above-average per capita energy consumption. It is only through political will and smart policies that countries can succeed in transforming their energy sectors towards sustainability. The German Renewable Energy Act, which was introduced by a coalition government of Social Democrats and Greens in 2000, has enabled Germany to rapidly increase its sustainable energy sector. It has also created more than 370,000 new green jobs in the renewable energy industry.

While many different players are already active in the wider field of renewable energy in the MENA region, their efforts have mainly focussed on facilitating business-to-business conferences, technical research, and energy financing issues. So far, little has been done in the fields of policy research, policy consulting, and public awareness to promote a sustainable use of energy in the region.

The FES is ready to share some successful policy experiences by providing German and international expertise, analysis, and policy advice to interested policymakers, activists, and researchers. The Arab Spring has strengthened our belief that public opinion can change politics everywhere. Since energy questions often relate to public interest (pollution, nuclear power, pricing), it is time to use the momentum of change for introducing ideas about clean and safe energy. It is our hope that new energy policies will bring about new, green, and fair jobs, economic development, energy justice, a solution to the many water issues of the region, and clean air for citizens from Tehran to Rabat.

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