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Renewable Energy: A Key to Enhancing the Societal Dimension of Energy Transition in Morocco

Recommendations for future cooperation

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Recommendations

\ Harness the potential of societal support for the renewable-based electricity-generating technologies

The potential of renewable energies (REs) goes beyond their contribution to mitigating climate and energy security concerns. Renewables have a high potential for societal support. Different Moroccan stakeholders from policy and decision-making institutions, civil society, academia, youth and industry prefer renewables-based electricity-generating technologies over conventional non-renewables-based technologies. To harness the full potential of societal support of the RE potential in Morocco, small and medium scale RE projects ought to be encouraged in parallel to large-scale projects.

\ Take into account societal preferences regarding the Moroccan National Energy strategy

There is an intrinsic benefit in streamlining the Moroccan electricity sector transformation process with societal preferences. It helps to foster a sense of ownership among Moroccan citizens. It also permits policymakers and project developers to count on societal support for the policies and the different energy projects. Moroccan stakeholders from policy and decision-making institutions, civil society, academia, youth and industry share and support the national vision of “a low carbon and climate change resilient development” but differ on the priorities of how to achieve it. Over the long

term, Moroccan stakeholders have a strong preference for replacing fossil energy sources by REs. Reducing import dependency and lowering electricity costs play a decisive role in these preferences. The stakeholders have even opted for a 100 per cent renewable energy scenario by 2050, whereby the largest share would be provided by wind and solar energy. Such a scenario underscores three of the key sustainability criteria deemed of high importance to the Moroccan stakeholders namely energy independence, electricity costs and water consumption.

\ Balance national and local impacts of the electricity sector transformation

In future implementation plans of the Moroccan National Energy Strategy, the societal dimension, i.e. the various impacts that the energy strategy will have on society and its different social groups at various levels ought to be emphasized. Beyond the techno-economic effects of the energy strategy on the national level, it has potential societal impacts on the well-being of the communities in the vicinity of the planned power plants. These impacts range from on-site job creation to physical safety, health and air pollution as well as pressure on local land and water security. In Morocco, renewable energies have a high potential of achieving the balance between negative and positive impacts both on the local and national levels compared to non-renewables.

Renewable Energy: A Key to Enhancing the Societal Dimension of Energy Transition in Morocco

Morocco's energy challenges lie at the intersection of the country's development and climate challenges. On the one hand, Morocco is highly dependent on imports of hydrocarbons and electricity. On the other hand, due to economic and demographic growth, the demand for energy has been growing progressively. According to the International Energy Agency IEA (2014, pp. 53,56), electricity annual demand increase between 2002 and 2012 has averaged between six to seven per cent, which means it has doubled in a decade and is set to double again in the course of the next two decades. A sustained increase in the demand for electricity is foreseen at least until 2030 (IEA, 2014, p. 60). If patterns of increase in electricity demand continue beyond 2030, electricity demand could as much as quadruple by 2050. Electricity-generation in Morocco is also hydrocarbon-intensive as it relies to over 90 per cent on burning coal, oil and natural gas making it a major contributor to CO₂ emissions (36.7% of total emissions in 2012) (IEA, 2014, pp. 27, 53). Due to a near universal electricity access¹, CO₂ emissions *per capita* are projected to increase more than twofold in the next 15 years (MEMEE, 2016, p. 98). In this light, Moroccan policymakers are faced with a complex energy challenge: To manage energy supply and demand and to attempt to phase out electricity subsidies² while ensuring electricity system stability and liberalizing the country's energy sector to attract necessary investment. The challenge of managing the societal dimension of such endeavour is equally complex.

Morocco's energy transition initiated

In 2009, the government of Morocco put in place a National Energy Strategy (NES) in which the electricity sector is set to undergo a substantial transformation by increasing the share of renewables in the total installed capacity to 42 per cent by 2020. The overall objective of this undertaking is to respond to the country's import dependency and climate change

risks. In 2014, the Framework Law 99-12 on the National Charter for the Environment and Sustainable Development was adopted to operationalize a holistic vision of sustainable development. The stated objective is to attain "a low carbon and climate change resilient development" (MEMEE, 2014, p. 18). This has resulted in specialized national agencies, a multitude of sector-specific action plans, national strategies, initiatives and programmes that address key sustainable development issues. Within this context, an updated version of the National Energy Strategy (NES) was adopted in 2015 setting targets for the year 2030.

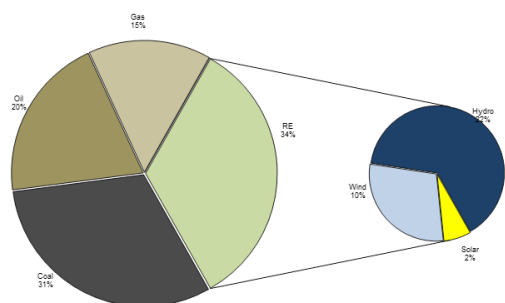
The renewed NES is the blueprint for Morocco's Energy Transition (ET) and the umbrella for the 2009 Moroccan Solar Plan (Noor) and the 2010 Moroccan Integrated Wind Energy Programme. Indeed, the cornerstone of Morocco's ET is to substantially expand the use of renewable energies infrastructure, especially of solar and wind. On the supply side, the NES's objective is to ensure security of supply by reducing the dependency on energy imports from 96 to 82 per cent by 2030 through regional integration into neighbouring markets as well as through increased exploration and exploitation of domestic fossil resources, particularly of oil and gas. On the demand side, the NES aims to increase the share of renewable energies in the primary energy demand from 15 to 20 percent and increase energy efficiency by 15 per cent by 2030. The power or electricity sector is set to undergo the largest transformation. By 2030, the target is to substantially increase the share of renewables in the total installed capacity from 34 per cent in 2015 to 52 per cent (20% solar; 20% wind; 12% hydro power). Accordingly, by 2030, the share of the different technologies in the installed capacity will change drastically as illustrated below.

1 \ Morocco has achieved electricity access for nearly 100 per cent of its population through the Rural Electrification Global Programme (PERG), launched in 1995.

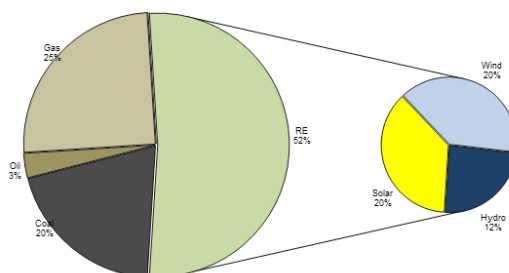
2 \ Energy subsidies constitute a burden on the national budget. Efforts have been made to phase out electricity subsidies following the 2007 elimination of subsidies on gasoline, kerosene and diesel.

Figure 1: Morocco's electricity sector transformation plans until 2030 in figures

Installed capacity in 2015 (in %)



Installed capacity in 2030 (in %)



Note: Shares of installed capacity in Morocco in 2015 and those planned for 2030 according to NES 2015. Source: Schinke, Klawitter, Barradi, Zejli, Garci and Leidreiter, 2016, p. 31. Calculations are made for the purpose of the MENA SELECT project based on official Moroccan data from Office National de Electricité et de l'Eau Potable (ONEE) and Ministère de l'Énergie, des Mines, de l'Eau et de l'Environnement (MEMEE).

Impacts and societal preferences

The targets in the electricity sector set for 2030 imply a transformation in the technical energy system that is organically linked to Morocco's society. To ensure the sustainability and robustness of the future electricity trajectory through the NES, it is essential to ensure that the trajectory contributes to attaining the national development objectives, has minimum adverse effects on the local level (i.e. local impact sensitivity) and corresponds to societal preferences—in short, the societal dimension of such electricity sector transformation.

Despite the positive attributes associated with the electricity-generating technologies based on renewables, some of their impacts remain ambivalent. Moreover, Moroccan societal preferences regarding different electricity-generating technologies remain understudied. Both impacts and societal preferences of electricity-generating technologies are context-specific. It is therefore vital to assess the local impact sensitivity of the different electricity-generating-technologies and juxtapose it with the technologies' contribution to the national goals. To ensure that NES is in line with societal preferences, it is important to assess the acceptability of the technologies by asking relevant stakeholders in the country to weigh the technologies' impacts according to their vision, priorities and preferences.

The NES includes eight of the most common and foreseeable electricity-generating technologies, four of which are renewables-based (concentrated solar power - CSP, photovoltaics - PV, wind and hydro power), and four are non-renewables-based (oil, gas, nuclear power and coal). In Morocco, the technologies' impacts on the national and the local levels are intrinsically linked to the country's development challenges (socio-economic and socio-ecological). The most relevant national aspects or criteria of the NES for electricity-generating technologies are: Use of domestic energy resources, electricity systems costs, value chain integration, technology and knowledge transfer and global warming potential. On the local level, the most relevant impacts are pressure on local land resources, direct job creation, local air pollution and health, pressure on local water resources, solid waste as well as physical safety.³

Technologies' contribution to national objectives and local impact sensitivity

By conducting a sustainability assessment (based on meta-analysis and regional data) of different electricity-generating technologies, one can assess the technologies' local impact sensitivity and their contribution to national objectives. Having assessed the performance of the four renewable and four conventional electricity-generation technologies (including nuclear power)

3 \ The national and local aspects or criteria were identified through a thorough review of scientific literature and screening of national policy frameworks in the target country.

against a set of eleven sustainability criteria with a corresponding total of 20 indicators (nine quantitative and eleven qualitative), it became clear that renewable energies were best-suited.

Judged against the country's sustainable development plans and targets and according to the sustainability assessment, renewables are more capable of contributing to the national energy planning objectives in the Moroccan context than non-renewables. The best performing technologies are PV followed by onshore wind and CSP. Nuclear, oil and coal have been found to contribute the least to national objectives. The technologies that perform worse are oil and coal. The assessment shows that natural gas-based technologies perform the best among non-renewables.

Renewables-based technologies have higher local impact sensitivity than non-renewables do. In other words, they have less adverse impacts on the local level. According to the same sustainability assessment, all renewables-based technologies perform better than all fossil-based technologies, mirroring the same ranking of performance regarding the contribution to national objectives.

Preferences of Moroccan stakeholders

How the technologies are accepted by the different relevant Moroccan stakeholders (representing policy and decision-making institutions, civil society, academia, youth and industry) not only depends on the technologies' impacts both on the local and national levels but also on how important these impacts are to the stakeholders. By conducting a multi-criteria decision analysis derived from a series of seven stakeholder workshops in Morocco, the team was able to assess the Moroccan societal preferences systematically, and accordingly the potential for societal support for the technologies which are planned to be part of the future electricity trajectory of the country:

- \ *Most preferred electricity technologies are renewables-based.* We found that renewable energy technologies are much more compatible with the preferences of Moroccan stakeholders than

their conventional alternatives. Moroccan stakeholders preferred PV most, followed by CSP, onshore wind and hydro-electric. Consequently, these technologies have the highest potential for societal support. The least preferred technology is oil-based. The reduction of import dependency and low electricity costs play a decisive role in these preferences.

- \ *Convergence of vision.* Moroccan stakeholders share the national vision of attaining "low carbon and climate-change resilient development" (MEMEE, 2014, p. 18). However, their concerns and focus are different when it comes to the question of how to attain it. While representatives of political decision-makers, finance and industry, academia and young leaders (albeit to a lesser extent) favour national development approaches to attain the shared vision over locally-relevant issues, representatives from national and local NGOs as well as local communities favour an approach that prioritizes locally-relevant impacts.
- \ *Divergence on the importance of local vs national impacts of technologies.* All stakeholders considered the use of domestic energy sources as well as technology and knowledge transfer (both nationally-relevant desired impacts) to be the most important impacts associated with the technologies. The safety, occurrence and manageability of hazardous waste (both locally relevant impacts) were considered the least important. The most discussed technology impacts were global warming potential and pressure on local water resources. The most contested criteria were the use of domestic resources (i.e. energy dependence), global warming potential, pressure on local water resources as well as electricity system costs.
- \ *Most preferred electricity trajectories are dominated by renewable energies.* Having conducted a multi-criteria decision analysis on electricity

modelling up to the year 2050 derived from a two-day multi-stakeholder workshop, Moroccan stakeholders clearly preferred future electricity scenarios made up of renewable energies. They even opted for a 100 per cent renewable energy scenario for 2050 as the most favourable scenario, whereby the largest share would be wind and solar energy. In such a scenario, stakeholders found three key sustainability criteria, namely energy independence, electricity and water consumption to be most important.

Concluding remarks

Morocco's future electricity demand is projected to increase substantially in the short to medium term. The choice of the necessary additional electricity-generation capacities to meet demand is tantamount to building the core of the country's electricity infrastructure. It represents an opportunity to reconfigure the country's energy system which goes along with reconfiguring the socio-technical system in place. As such, this opportunity is also a peril in disguise since any reconfiguration cannot be done in isolation from the complex development challenges faced, the society and its preferences.

As the energy strategy in Morocco moves along national plans, there will be a paramount need to further understand their impact on the Moroccan society and its preferences regarding them. Research on the transformation of the energy systems has been by and large from a technical point of view that did not much take the societal dimension into account. To advance the Moroccan energy transition to sustainability, this dimension must be strengthened by balancing between local and national impacts and considering societal preferences. In expanding the use of renewable energies, there is significant potential for achieving both.

About the MENA SELECT project

The research project MENA Sustainable ELECTricity Trajectories (MENA SELECT) aims to identify electricity trajectories until 2050 that are cost-effective, capable of advancing the national development objectives and most in line with societal preferences as judged by the different stakeholder representatives in the country (i.e. conflict sensitive). The project covers three MENA countries: Morocco, Jordan and Tunisia. It is supported by the German Federal Ministry for Economic Cooperation and Development (BMZ) and conducted by five research institutes: Bonn International Center for Conversion - BICC, Germanwatch, International Institute for Applied Systems Analysis IIASA, the Wuppertal Institute, and Europa-Universität Flensburg.

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