FROM LAGGARD TO LEADER? MALTA'S TRANSITION TOWARDS LOWER CO_2 EMISSIONS AND A LARGER RENEWABLES SHARE WITH ASPECTS OF ENERGY STORAGE

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Introduction

In 2005 the island state of Malta was the only European Union member country with a renewable energy consumption share of zero percent, and it was not before 2011 that a one percent share had been achieved. Meanwhile electricity production from non-renewables is mainly based on imported heavy fuel oil that is associated with high levels of both local air pollution and CO2 emissions per kWh generated. (Heavy fuel oil accounts for ca. 86 percent, gas oil for 14 percent.) In fact, to serve the population of just over four hundred thousand, some 1.9 million tonnes of CO2 have been released in 2011 at the two power stations that combined comprised a generation capacity of 571 MW, compared to a base load of ca. 160 MW and a peak load of somewhat above 410 MW.

The Upcoming Power Infrastructure

According to the general election campaign pledge by the party in government since March 2013, Malta is currently shifting its electricity generation infrastructure from oil to gas. At the core of this plan is an LNG Floating Storage Unit with a land-based regasification installation supplying a 200 MW gas-fired power station that should be built and commissioned within two years. (There are no gas pipelines to Malta and natural gas is currently not being used.) In addition, a new 144 MW extension at the more modern one of the two existing power stations (Delimara) came into operation in December 2012 and will be converted to use natural gas as well, while it was originally designed to run on diesel. What is more, an interconnector to Sicily is under construction to be commissioned in late 2014. This 200 MW HVAC (220kV) submarine cable will connect the currently isolated Maltese grid to the European grid. Meanwhile, parts of the older, heavily polluting Marsa power station (total capacity: 267 MW) have been closed down when the Delimara extension came into operation, and the remaining 130 MW worth of steam turbines in service at Marsa will retire as soon as the interconnector to Sicily comes online. At the Delimara station, with a total capacity of 304 MW plus 144 MW, a 120 MW steam plant will be decommissioned when the new gas plant is functional (supposedly in 2015).

In the somewhat more distant future, Malta might also be connected to Sicily through a natural gas pipeline. Such plan has been selected by the European Commission as "project of common interest" (PCI) under the guidelines for the trans-European energy infrastructure (TEN-E) and will thus be eligible for European funding. Generally, such project benefits at least two Member States; contributes to market integration and further competition; enhances security of supply, and reduces CO_2 emissions. This particular PCI has been defined as a 150km pipeline with a capacity of 4.4 MCM/day from Sicily to an offshore storage unit in Malta, and a 12 km pipeline from this unit to Delimara [1].

Current Status of Renewables

Regarding renewables, Malta was committed to achieve a 10 percent renewable energy consumption share by 2020. With substantial resistance against onshore wind installations in one of the world's most densely populated countries, and water depths prohibitive to conventional offshore wind technology almost everywhere around Malta, the former government decided to base the largest fraction (one third) of the national renewable energy plan on a single reef-based offshore wind park of

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95 MW. Meanwhile, imported biofuels account for nearly a quarter and PV for below 7% of all renewable contribution [2], [3]. However, with both offshore wind and the minimal onshore wind projects remaining in the planning phase, the most significant contribution of grid-connected renewable electricity in fact comes from photovoltaic installations whose total capacity reached 16 MW by the start of 2013.

Methodology

The purpose of this study was to analyze the effects of the upcoming changes in the Maltese power sector in terms of carbon dioxide emissions and renewables integration. Carbon emissions were calculated on the basis of fuel and power plant efficiencies, with source assumptions made regarding imported electricity (interconnector). Future electricity demand up to 2030 was estimated based on current demand and official demand projections to 2020, and compared to the supply capacity of the upcoming fossil electricity infrastructure to see how large a role there might be for renewable energy. Hourly electricity demand patterns were compared to renewables supply patterns, and storage technologies were reviewed to investigate options to balance generation and consumption periods.

Results and Conclusion

The shift from heavy fuel oil to natural gas will clearly be a substantial leap forward in terms of lowering carbon dioxide emissions per kWh of electricity produced in Malta. Similarly, power imported through the interconnector will be associated with lower emissions per kWh generated when compared to the current situation. Though the interconnector will provide for more grid stability that would allow Malta to integrate large, intermittent renewable energy installations, and the Maltese grid might then indeed be viewed as a Micro Grid connected to a larger network, the prospects for wind power are not bright for the time being. Besides the mentioned resistance against onshore wind, it has been demonstrated that the planned offshore wind park is a lot more expensive in terms of LCOE when compared to onshore wind and photovoltaics [4], and it has to be assumed that the private sector investor (Independent Power Producer) who agreed to carry the investment for the new gas infrastructure would have requested a guarantee to sell electricity close to the plant capacity of 200 MW, which is only slightly above the base load. Thus, there will be a strong focus on PV capacity that delivers electricity during daytime, while wind integration, especially relevant with renewable energy goals increasing beyond the 2020 targets, would work best in combination with an energy storage infrastructure. Two options have been identified that are specifically geared towards local settings. One is Seawater Pumped Storage at cliffs over 200 meters high in the west of Malta. (At present there is globally only one such plant operating, at Okinawa, Japan [5].) The other option is Ocean/Offshore Compressed Air Energy Storage (OCAES) that works along similar principles as traditional CAES, but utilizes the pressure prevalent at great depths in oceans [6].

Literature

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