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Interconnecting an isolated electricity system to the European market: The case of Malta

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ABSTRACT

The long-term European Union (EU) energy policy increasingly requires member countries to reform existing power systems, including those of small island states. These are commonly isolated electricity systems that rely heavily on imported fossil fuels. Interconnections with mainland power systems are an alternative to offset the exposure to volatile fuel prices. This paper studies the 200-MW (MW) subsea transmission cable between the EU island member state of Malta and Sicily that was inaugurated on April 2015. Our main purpose is to examine whether and to what extent Malta's vulnerability to distinct oil price scenarios can be overcome with this new interconnector. We describe the process used to simulate the merit order for both Malta's isolated and interconnected electric generation setup. The algorithm used provides the average electricity spot price and economic scarcity rent of electricity imports and exports. The main finding is that the Malta-Sicily interconnector does not necessarily lower electricity prices for Malta's consumers. However, some scenarios, notably the incorporation of natural gas in Malta's future generation portfolio, achieve win–win situations for both consumer and supplier. The Malta case study shows that cable impacts depend on the installed generation capacity, oil price, and market design.

1. Introduction

In light of European electricity market liberalization, this article addresses the grid interconnection, specifically a high voltage subsea cable with 200 MW transmission capacity, between the two EU member states of Malta and Italy. Up until April 2015, Malta's electric power system was isolated; consequently the country relied heavily on imported fossil fuels (namely, oil). Malta's exposure to volatile oil prices impedes the ability to reliably predict electricity generation costs. This motivates our investigation to determine whether and to what degree the vulnerability to distinct oil price scenarios can be overcome with the new interconnector.

An isolated power system, like that in Malta, implies peculiarities. This study thoroughly examines whether the interconnection cable to Sicily breaks up the Maltese market and potentially threatens the privileges of the incumbent utility Enemalta. It presents the drivers that have forced the small EU member state to radically revise its existing energy policy. Without interconnecting isolated electric power systems (EPS), the islands (states) run the risk of not being able to satisfy the demand in situations when external fuel import is disrupted.

The motivation to study this interconnection problem is manifold. First, Malta's case represents an excellent example where technological characteristics, the landscape of domestic stakeholders, and economical singularities can be studied from a micro perspective. Moreover, it is particularly interesting to analyze how Malta as a EU island member state is implementing the current European policy framework. Malta became a sovereign EU member state in 2004 but unlike most EU islands (such as the Canary Islands, Spain), it does not have the support for compliance with EU

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law that benefits countries belonging to mainland members. Since Malta is a fully independent EU member state, derogations from binding directives are necessary.

As a practical approach and tool, this paper applies the merit order concept (Joskow, 2006; Stoft, 2002) to numerically determine the interconnector's potential for the Maltese electricity market. We first construct the merit order curves for Malta's isolated power system by differentiating between three distinct oil price scenarios. Then the interconnection case is simulated. The algorithm (provided in Appendix A) enables us to calculate the key indicator of average electricity spot price with and without the interconnector. It also computes economic scarcity rents that result from electricity imports and exports.

2. Evolution of EU electricity market opening

2.1. Characteristics of Malta's isolated electric power system

In Europe, a form of liberalized electricity market was present in the first third of the 20th century. Spontaneous growth of private companies took place and the state adopted the role as "observer" (Batlle, 2013). A first major restructuring of the electric power industry due to reduced investment capacity following WWII, shifted responsibility for the electricity sector to the state in almost all European countries. Until the 1980s, all power-supply activities were regulated within a monopolistic framework. Large economies of scale in generation and the "nature of the service" in networks fostered this development. Toward the end of the 20th century, reform of the electricity sector in Europe seemed ineluctable. Different motives across world favored the transition from state driven monopolies to liberalized market places. In particular, the entry of new generation technologies, rapid growth in demand, and transmission expansion (Batlle, 2013) allowed private firms to enter into the competitive segments (generation and retailing) of the industry. In many markets, their entry has challenged the traditional paradigm of the single, vertically integrated public utility. The European Commission (EC) has enacted three "energy packages" to gradually open the market. The most relevant directive for this paper concerns the creation of an internal European electricity market (2009/72/EC).

According to the EC's legislation Malta is considered a small, isolated system. The island state therefore benefits from derogations in directive 2009/72/EC. For now, Malta does not have to comply with distribution system operator (DSO) unbundling (Article 26), third-party access (Article 32), and market opening (Article 33) (Malta Resources Authority, 2013). However, the prospective commissioning of the submarine interconnection cable between Malta and Sicily possibly abrogates these exemptions.

A common feature in liberalizing the energy sector of many EU member states is the establishment of electricity wholesale markets. These markets provide for different ways of selling generated electricity. At the core of these wholesale markets is the day-ahead market (DAM), where electricity is traded one day prior to physical delivery. In Malta, such a trading platform does not exist. Electricity generation and its remuneration are centralized. Absent market forces, the Maltese government entrusts the national regulator with fixing regulated electricity tariffs for consumers. Today consumers do not purchase electricity at real costs. The government heavily subsidizes Enemalta, so that the "national champion" is capable of offering affordable electricity prices (International Monetary Fund, 2015). The heart of the island's electricity grid is the distribution network for which Enemalta is the responsible DSO. Malta's high voltage network consists of only two 132 kV lines and many 33 kV and 11 kV circuits. Although few independent electricity self-generators co-exist (e.g. roof top solar photovoltaic installations), Enemalta produces the lion's share of electricity and is the single operator for retail electricity to consumers. Beyond its role as power producer and retailer, Enemalta's responsibility includes dispatching and ancillary services provision.

2.2. The Malta-Sicily interconnector

The literature on electricity interconnection economics defines an interconnector as an asset in the form of an underground or overhead transmission line whose purpose is to link and to enable electricity transfer between two individual electric power systems (Cortea and González-Pedraz, 2012; Turvey, 2006). The interconnector studied in this article is a high voltage alternating current (HVAC) subsea cable. Fig. 1 locates the cable installation between Malta and Sicily within the Mediterranean Sea.

European-wide energy policies started to concern the Maltese archipelago only after its official entry into the EU. Malta's aged electric power infrastructure will necessitate mandatory shutdowns as some power units (e.g. Marsa power station) approach technical lifetime limits and non-compliance with EU law (e.g. Industrial Emissions Directive). The EU Energy Roadmap 2050 (European Commission, 2011a) requires the Maltese government to set up measures to address the island's unsustainable, exclusive fossil fuel based energy mix. Before the sectoral liberalization process had started, incentives to invest in interconnection capacity and environmentally friendlier generation technologies did not exist. A request by Enemalta for information regarding a submarine electrical interconnection between the Maltese and European grids was first launched in 2007. It lists the five essential drivers as follows (Enemalta, 2007, p. 2–3):

1. "One vertically integrated corporation currently serves Maltese consumers for the generation, distribution and supply of electricity through a totally isolated network. An interconnection between Malta and the European mainland would help the development of an efficient internal energy market."
2. "The need to ensure that Malta's supply of electricity is secure requires a change in the current situation where the country's fuel needs are provided solely through liquid fossil fuels imported from third countries rendering it particularly vulnerable to disruption […]."
3. "Malta's efforts to comply with EU directives regarding emissions of pollutants […] will be greatly aided by purchasing electricity from the European grid. Furthermore Malta would be able to purchase electricity generated by renewable sources […]."
4. "An interconnection with the European grid would help Malta observe the target stated in the Presidency Conclusions reached at the Barcelona European Council in March 2002, to increase minimum electricity interconnection levels between member states to 10% of their installed production capacities."
5. "An interconnection to the European electrical network would be instrumental for the integration of a large intermittent source of renewable energy such as the proposed multi-megawatt offshore wind farms. With such wind farms

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