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Solar energy for Sicily's remote islands: On the route from fossil to renewable energy

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Abstract

Following first attempts in the early 1980s that provided useful information on the reliability of the photovoltaic energy generation, Sicily's remote islands share a number of pioneering achievements in the utilization of solar energy. This study aims to assess progress and the remaining gaps in the large-scale adoption of renewable energy in said numerous islands. We identify the most advantageous technologies and suggest pragmatic actions, so as to allow new stakeholder commitment for further progress in the forthcoming transition from fossil to renewable energy.

Keywords: Solar energy in minor islands; Islands' sustainable development; Photovoltaic energy; Distributed generation

1. Background and introduction

Sicily, the most solar irradiated Italy's region (Šúri et al., 2007), has 14 remote islands: three (Favignana, Levanzo and Marettimo) comprising the Egadi Islands archipelago off the coast of western Sicily; seven (Alicudi, Filicudi, Panarea, Salina, Vulcano, Lipari and Stromboli) making up the Eolian Islands off the northern coast, another off the west northern cost (Ustica), and three off the southern cost, between Sicily and Tunisia (Lampedusa and Linosa comprising the Pelagie archipelago; and Pantelleria: the largest among Sicily's remote islands).

Blessed with plentiful sunshine, selected islands have hosted some of Italy's most significant first attempts in the study toward large scale utilization of solar energy. For example, Vulcano hosts since 1984 a large photovoltaic (PV) field that in the subsequent three decades will show remarkably stable performance (see below).

Like in the rest of the world, interest in renewable energy technologies remained idle until the late 1990s. A revival of attention started in the late 1990s and early 2000s when the European Commission financed a number of joint studies in which Sorokin in Italy and co-workers from other EU countries undertook and published a number of pioneering studies on renewable energies in the Mediterranean islands (Giampieri and Sorokin, 1997), that in the subsequent two decades will provide useful guidelines to a number of the Mediterranean islands now approaching 100% renewable energy supply (see below).

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A new work investigated grid control systems (Tselepis et al., 2000) for PV energy introduction in Greek, Italian and French island grids (Tselepis et al., 2001), and the opportunity of introducing PV modules on the roofs of Italy's minor islands when the price of solar modules was still greater than €7/W (Sorokin et al., 2002).

At the end of the first decade of the 2000s, the cost of both photovoltaic and wind electricity approached and then went below the so-called "grid-parity". Suddenly, the idea of a full transition from fossil to renewable power in remote islands became a serious topic of discussion and field of action both in Italy (Sorokin, 2014) and worldwide (United Nations, 2014). The Mediterranean El Hierro Island in the Canary archipelago, for example, now generates 100% of its energy from a mix of renewable sources to supply power needs for its approximately 12,000 residents, saving over 40,000 barrels of oil and 1.8 million euros each year, by foregoing importation of fossil fuel (Morales Clavijo, 2015).

Being located in areas with an abundance of wind, sunshine and water, as well as relatively small, remote islands have geographically ideal conditions for almost all forms of renewable energy (Gilchrist, 2014).

Currently, Sicily's islands import fossil fuels, mostly diesel, to meet their significant energy demand. Electricity, indeed, is not used only to power residential buildings, hotels and small and medium enterprises (SMEs), but also to desalinate seawater to meet the demand of fresh water. This has led to rapidly surging energy costs in the course of the first decade of the 2000s, during which the price of oil surpassed the $100/barrel threshold.

Like in many other remote islands in the world, this has caused a renewed interest to diminish reliance on expensive and difficult to transport fossil fuels using renewable energy. In a few years, the use of solar water heaters became a common practice in most Sicily's islands, translating in significant fossil fuel and financial savings, as most inhabitants of these islands continued to use electricity to generate hot sanitary water.

Unfortunately, Sicily's restrictive regional regulation *de facto* prevented a similarly rapid adoption of PV energy as building owners are usually required to receive explicit permit from regional authorities.

This study aims to assess progress and the remaining gaps in capillary penetration of solar energy in Sicily's remote islands. We identify the most advantageous technologies, and suggest pragmatic actions, in order to allow new stakeholder commitment for further progress in the forthcoming transition from fossil to renewable energy.

2. Achievements in using solar energy

Sicily's remote islands share a number of pioneering achievements in the utilization of solar energy. Installed and connected to the island grid in 1984 in Vulcano, part of the Eolian archipelago, the 180 kW PV plant comprised of 9% efficient monocrystalline silicon PV modules (Fig. 1) has shown remarkable stable performance.

Thorough measurements of energy generation are carried out by Italy's researchers every year since its installation. After 21 years since its installation the PV array had lost only 6% of its original production capacity (CESI,

Figure 1. Two PV fields (80 kW the one on the right; 100 kW the other) comprised of different crystalline silicon solar modules installed in the island of Vulcano, Sicily.