Description of integrated pilots/demonstrations/field tests/existing practices

1. Name of the case

   Renewable energy-buffering systems in minor islands

2. What is integrated with DSM

DG	x
Energy storage	x
Smart grid technologies	

3. What is the level of commercialization

Research project	x
Demonstration	
Field test	
Existing practice	

4. Where to find more information?

- Contact person:
  University of Rome "La Sapienza"
  Franco Rispoli, rispoli@dma.ing.uniroma1.it
  Alessandro Corsini, alessandro.corsini@uniroma1.it
- References:
  Corsini A., Gamberale M., Rispoli F., "*Assessment of renewable energy solutions in an Italian small island energy system using a transient simulation model*", ASME J. of Solar Energy Engineering, 128, 237-244, 2006.

  Corsini A., Rispoli F., Gamberale M., Tortora E., "*Assessment of H_2 and H_2O-based renewable energy-buffering systems in minor islands*", Renewable Energy, RENE-D-07-00152, 2007.

Description of integrated pilots/demonstrations/field tests/existing practices

5. Objectives of the case

The project assesses the energetic and environmental performance of two storage solutions designed to complement renewable energy technologies, in stand-alone power system (SAPS) configuration typical of minor Mediterranean islands.
The objective of the study are

- the evaluation of the fuel-oil need reduction in SAPS by using renewble energy;
- the comparison of a hydrogen-based system and a desalinated water production system, proposed as two effective alternatives for renewable energy seasonal buffering in a SAPS context, in order to demonstrate their storage capability and their attitude to balance the seasonally varying electricity demand of a minor-island or to satisfy its water request.

6. Business rationale/model

From the energy demand side, the island stand-alone power systems (SAPS) feature specific installed power capacities higher than the national grid (i.e. *0.7 ÷ 0.8 kW* per inhabitant) ranging from *1 kW* per inhabitant in the larger islands to almost *10 kW* per inhabitant in the smaller ones. Nevertheless renewable energy technologies in small islands are encouraged by number of favourable conditions which exploit a reduction of the pay-back times (e.g. the climate conditions and the stand-alone configuration leading to higher electricity production costs).

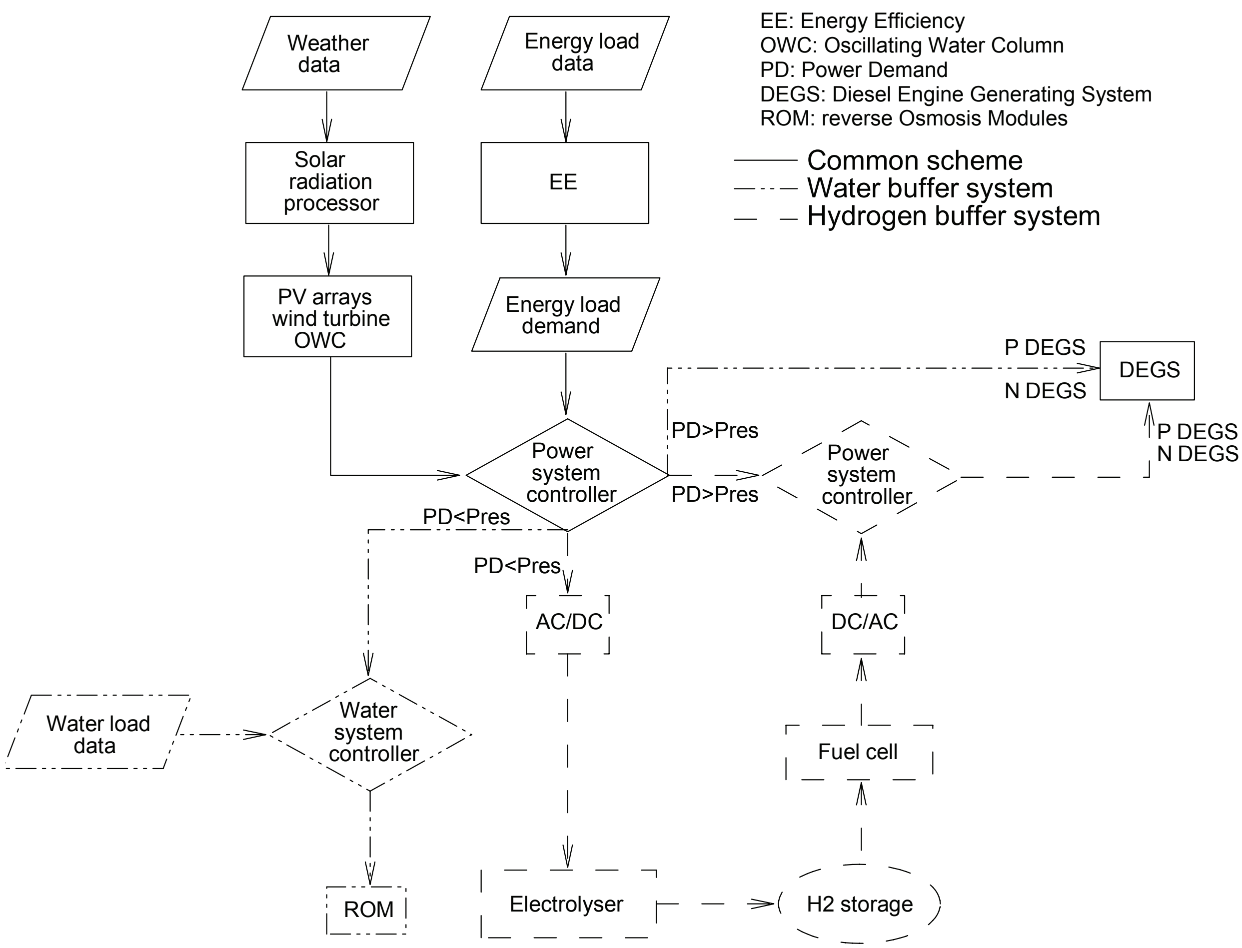
7. Technologies used

In order to analyse the energy system of the minor island a transient simulation model was developed in the TRNSYS framework, integrated with the HYDROGEMS library, and OWC in-house made library. The energy system was divided into four main subsets of components, namely: the generating system, the final uses, the control system, the energy storage system. The meteorological data influences the renewable energy source (RES) technologies, leading to renewable energy surplus. The power system and the demand side system are connected by the control logic, which analyses the amount of available renewable and eventually fuel cells energy, and activates a pre-defined start-up sequence.

8. Short description of the case

The proposed models, include RES integrated with a hydrogen based production-storage-utilization cycle or a desalination water production, eventually fed by the surplus of converted renewable energy. In view of the winter RES peak productivity, the hydrogen power system is considered as an effective option for the seasonal energy buffering entailing the use of stored hydrogen as a renewable energy carrier, while the desalination plant is considered as a solution for reducing the impacts related to clean water supply.

The logical structure of the model is described by the flowchart in the figure below. The meteorological data influences the RES technologies, leading to renewable energy surplus. The power system and the demand side system are connected by the control logic, which analyses the amount of available renewable and eventually fuel cells energy, and activates a pre-defined start-up sequence.



Minor island energy system, the TRNSYS model chart.

Description of integrated pilots/demonstrations/field tests/existing practices

9. Achieved/expected results (operational savings, CO_2, efficiency enhancement)

   Although the studied buffering systems have different purposes, in each scenario the most important effects are the reduction of both the number of diesel generators operated in parallel and the working time, entailing fuel saving and carbon dioxide emissions abatement. Both the scenarios lead to fuel oil savings greather than 60% with respect to the existing system. The higher fuel oil saving values in the *hydrogen-based scenario*, compared to the *water-based* one, result from the fuel cell energy contribution which allows a further reduction of DEGS firing hours. The DSM and RES interventions globally entail *1317.2 tons* of avoided CO_2 emissions per year in the *hydrogen based scenario* and *1224.9 ton* per year in the *water based* one.

10. Lessons learnt

    The developed models provide a user friendly tool capable of aiding the definition of local energy policies. In the study case of an island, the comparative assessment of the performance of the studied scenarios has been carried out providing information about the buffering potentiality.