

Deep decarbonisation of the Italian energy system based on renewable energies: a technical analysis

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ABSTRACT

The Italy's National Energy Strategy approved in 2013 sets some explicit targets for the year 2020. Later, it becomes vague and simply recalls the need to be in line with the European Roadmap 2050, therefore reducing emissions by 80% (relative to 1990 levels) [1].

This work has two objectives: i) to investigate the technical feasibility of this 2050 target excluding nuclear energy, power plants with CCS, and Enhanced Geothermal Systems; ii) to identify key unavoidable measures by comparing different future scenarios.

Our analysis is based on the software "REMod" (Renewable Energy Model), an optimization tool developed by the Fraunhofer Institute for Solar Energy Systems [2]. REMod examines all energy sectors with an hourly time step for a whole year, and identifies the least-cost system configuration.

Results show that energy efficiency and electrification of final consumptions in buildings and transportation are mandatory to reach the target, together with a strong growth of all renewables, particularly photovoltaic plants. New elements of flexibility are essential to integrate over 70% of non-programmable electricity in the energy system: hydro pumping, batteries, combined heat and power plants, heat pumps, power to syngas and power to heat solutions.

This study helps to imagine an alternative future based on a defined portfolio of technological solutions. It highlights the tremendous scale of the challenge that has to be faced. Light duty vehicles should be all electric. Electricity production from wind and PV needs an unprecedented level of deployment for its rapidity and long lasting increase: the resulting growth rate is higher than that observed for electricity from fossil fuels during the Italian economic miracle after the end of the Second World War, and it is equal to the one observed for wind and PV in the period 2010-2013 during the generous Italy's renewable energy incentive scheme, but it needs to last without interruption for 35 years.

Keywords: decarbonisation; electrification; energy system modelling; renewables; smart energy systems.

References

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