Long term CO2-free power generation scenarios for Italy

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Achieving carbon neutrality around 2050 is an unprecedent technological, economic and social challenge. It means changing the way energy is used, by means of more efficient technologies, increasing the electricity share in final consumption and introducing, in some sectors, new energy carriers such as hydrogen or synthetic fuels derived from it. Hydrogen in turn, in the long run, will have to be produced mainly by electrolysis. As a consequence, in spite of significant improvements expected in energy efficiency, electricity demand will be at least twice the present value. In Italy around 650 TWh against 320 TWh today. Making available, each hour of the year, the electrical power required by loads, for a total of 650 TWh, without any greenhouse gas emission, is a further challenge. Analyzing all possible scenarios, together with their technical, economic and social implications, in order to be able to implement the most convenient one, is a necessary condition to try to win it.

This talk will present some power generation long term scenarios in Italy, that take into account the hourly generation curves of variable renewable sources and the hourly curve of electricity demand that can be expected over a whole calendar year, for a total of 650 TWh, to be satisfied by a mix of CO_2-free technologies. The focus is on costs; electricity market rules determining prices are not considered. To measure the total cost of each kWh actually delivered to loads at the time of demand, a new parameter is proposed, called *LCOTE*, which takes into account the costs (capex and opex) of all generation and storage technologies, necessary to meet the demand in every hour of the year, levelised according to the usual IEA procedure. For each scenario, the optimal mix has been found that, under the assumed constraints, shows the minimum LCOTE. Due to the adoption, as for the grid, of the so called "copper plate" simplifying assumption, we didn’t take into account the costs of the necessary upgrading of transmission and distribution networks, which would be higher in scenarios with larger renewable capacity. Nevertheless, the results show that LCOTE is lower for scenarios with a share of base-load generation, provided by either nuclear fission or fusion power plants. In addition, which is even more relevant, those scenarios need up to 3 times less renewable capacity, than a 100% renewable scenario, with a consequent similar land use reduction.