Scenarios for power generation in Italy

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According to several international pledges on climate change, de-carbonization of the energy systems is a shared goal, almost worldwide. In particular, already in 2011 the European Union has adopted an Energy Roadmap aiming at a fully decarbonized electricity generation by 2050. Hence, two main options will be available for the European electricity mix in the second half of this century: either to rely on renewable energy sources only, or to integrate renewables with a new generation of base load, low-carbon technology, e.g. fossil fuel power plants with CCS (Carbon Capture and Storage) or nuclear power plants. As for nuclear, besides III+ and IV generation fission reactors, the real game changer, by the last quarter of this century, could be fusion.

If only renewable technologies are used, a large share of variable renewables (solar and wind) is necessary, and over-generation and under-generation can happen for several hundred hours in the year, thus large storage capacity and/or dispatchable generation are necessary to fulfil demand, together with a consistent increase of the transmission and distribution grid capacities. On the other hand, the size of the necessary storage systems, dispatchable power plants and additional grid capacity can be reduced if a base-load low-carbon power technology is also included in the mix.

In this talk, a number of power generation scenarios will be presented, referring to typical North-Europe (windy) and South-Europe (sunny) cases, in order to investigate whether and to what extent a base load technology such as fusion might be a cost-effective ingredient of a future European decarbonized power mix. The scenarios are defined through the CO.ME.S.E. (COsto MEdio del Sistema Elettrico - Electric System Average Cost) code, which search for the conditions to guarantee the hourly balance between load and power generation, over a one-year timeframe, i.e. it provides the generation capacity (both variable and dispatchable) and the storage capacity, necessary to compensate the variability of renewable energy sources. The code also provides the *Levelised Cost of Timely Electricity*, i.e. the classical Levelised Cost of all generated electricity (including electricity that is curtailed when too large over-generation occurs and back-up electricity, which is necessary instead when under-generation occurs) plus the cost of storage systems.