Problems connected to the integration of non-programmable RES into the power system: the EU and the Italian case

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Summary

Following the Rio Summit of 1992,climate change has become a priority issue for the mankind but binding agreements on GHG (Greenhouse Gas) emission reduction valid worldwide have not been reached yet. The European Union has set regional binding targets with its "20-20-20" Climate and Energy Package approved in 2009, followed in Dec. 2011 by more ambitious targets implying a dramatic reduction by 2050 of GHG emissions to 80-95% below the 1990 levels. As an intermediate step along the roadmap towards the 2050 challenging targets, the European Commission (EC) proposed in January 2014 a binding target of 40% GHG cuts with respect to 1990 to be attained by 2030 and in March 2014 the European Council agreed to examine the EC proposal and a final decision is expected in October 2014 after the EU parliamentary elections in May 2014 and the UN climate summit in September 2014.

After a review of the present world situation with respect to primary energy resources, electricity production and CO_2 emissions, the paper addresses the present and foreseen penetration of the power generation from RES (Renewable Energy Sources) in the EU (European Union), underlining also the economic impact on final clients caused by generous feed in tariffs.

A special focus on the Italian situation is later on presented and discussed. Indeed, the country has witnessed a boom of the installations of non-programmable RES generation, particularly PV, and examination of the "Italian case" is particularly instructive for other regions of the world where clean electricity generation is becoming a priority. The impact of a substantial increase of RES generation both in power and energy on the power market operation and system reliability and security are presented with practical examples; e.g.: distortion of the day-ahead power market prices, critical load following requirements for conventional plants, need for additional reserve and risk of excess of non-programmable generation ("overgeneration") in some hours, risk of dynamic stability and worsening of power quality.

The main solutions to overcome the above problems are reviewed. These are pertinent to all stages of the power sector, from generation to demand and are part of the broad scopes covered by "smart grids" concepts. The paper will illustrate the contribution that conventional generation, demand, T&D networks and storage facilities can give to maximize the share of RES generation in a power system while ensuring its reliability and security standards.

More in detail, the paper will give the answer to the following question: "*when in a power system the generation mix - demand pattern - network configurations - and possible energy storage devices are given, what is the maximum penetration of non-programmable RES generation* ?". To answer this question CESI has developed a methodology that through a series of five steps can give a clear indication of the maximum share of RES generation, also identifying what are the constraints preventing the attainment of higher limits.

This methodology has been already applied by CESI in a series of studies related to a number of European and Mediterranean countries.

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In authors' opinion, the technical and economic aspects must be treated together and it is mandatory at world level to arrive quickly at agreed costs for the environmental impact of electrical infrastructures, particularly CO_2 and other GHG emissions. Coherently, new RES generation and related network assets must be planned a priori in an appropriate way to be a real asset and not a problem a posteriori.