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ASSESSMENT OF THE NEED OF SUBSIDIZATION FOR LONG-TERM DEVELOPMENT OF RES AND MICRO CHP PLANTS IN THE ITALIAN POWER SYSTEM

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Overview

The increasing world energy needs deriving from the economic growth of both developed and, especially, emerging countries such as China and India, together with the well known criticalities due to geopolitical instability, during the last years led to a significant raise of prices of fossil energy sources, as well as to growing concerns about security of supply.
On the other hand, it appears more and more evident that a development model heavily based on fossil energy sources is becoming hardly sustainable, not only from the economic point of view, but in particular from the environmental one, taking into account its impact on climate changes and on air quality.
Such problems are especially critical in Italy, due to its high dependence on imported energy sources and to the stringent constraints deriving from the application of the Kyoto Protocol.
To tackle these problems, besides actions aimed at increasing efficiency in end-uses, the main focus is on the development of renewable energy sources (RES), as well as on a more efficient use of fossil fuels through new technologies and combined heat and power (CHP) plants.
Within this context, aim of the paper is to present the results of a scenario analysis on the development of the Italian electricity generation set till 2030, with a special attention on RES, taking into account their potential and the related incentivizing policy measures, as well as on the new paradigm of dispersed generation based on micro CHP plants.
In particular, the analysis is aimed:

- at verifying whether the current schemes and levels of subsidies are sufficient to saturate the different RES installation potentials over the considered time horizon and at assessing the compatibility of RES development with the targets defined by the European Commission;
- at verifying the need of subsidies to foster the penetration in the residential sector of dispersed generation based on micro CHP plants, as well as at assessing the benefits they can provide in terms of reduction of fossil fuels consumption and of CO_2 emissions.

Methods

The simulation tool used for the study is the multi-regional model of the Italian electric system MATISSE, developed by CESI RICERCA and based on the MARKAL-TIMES model generator developed by the Energy Technology Systems Analysis Programme (ETSAP) of the International Energy Agency (IEA).
MATISSE can combine the energetic, socio-economic and environmental constraints of scenarios set up by the user to determine the optimal configurations (in terms of least overall cost) of the power system, both on the demand side, making compete different end-use technologies to provide the required energy services, and on the supply side, making

compete the different generation technologies available to meet demand, over a time horizon of a few tenth of years (the present study extends to 2030).
A distinctive characteristic of the model MATISSE is its representation of the Italian power system as a set of smaller power systems, one for each of the 20 Italian regions, modelled as interconnected by the high voltage transmission network: this allows a more detailed and realistic simulation of the operation and of the evolution of the overall system taken into account.

Results

In the optimal (system least cost) scenario simulated by MATISSE, the current schemes and levels of subsidies incentivizing the development of RES have been modelled, but without imposing any cap both on total expenses for subsidies and on the amount of RES production eligible for subsidization.
In this scenario, RES production increases from 50 TWh in 2005 to 133 TWh in 2030 (over an overall maximum potential of 151 TWh), due to the substantial saturation of the installation potential of geothermal (100%), thermodynamic solar (100%), hydro (97%), wind (96%) and biomass (92%) sources. On the other hand, such incentives are not sufficient to develop photovoltaic solar (70%) and biogas (50%) sources till their maximum potential. This RES development could be sufficient to reach the 76 TWh 2010 target reported in the 2001/77/CE Directive. As for the longer term target set in the "Renewable Energy Road Map" of the European Commission, corresponding to the 20% of the gross inland energy consumption by 2020, it shall be translated into national and then sectoral targets, not defined yet. Anyway, in the analyzed scenario, RES contribution becomes more and more significant, growing from 19% in 2010 to 26% in 2030 w.r.t. the gross inland electricity consumption.
Moreover, the study shows that without specific subsidies there is no significant penetration of dispersed generation based on micro CHP plants in the residential sector. Anyway, it must be taken into account that this result is determined by the MATISSE model from the system optimization (least overall costs) point of view; in practice, the conclusion could be different by taking the point of view of the owner of the micro CHP plant, who is exposed to the electricity market prices that could be significant if compared to its generation costs.

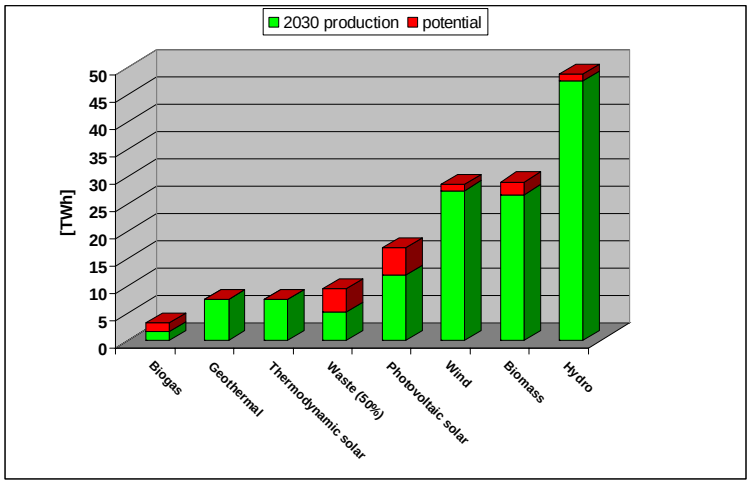

Fig. 1: RES electricity productions in 2030 w.r.t. their potentials.

By forcing the installation of the full potential (4300 MW) of micro CHP plants in the residential sector, w.r.t. a scenario where the cogenerated heat is produced by a conventional natural gas boiler, there is a small increase in gas consumption (0.19 Mtoe over 27.3 Mtoe), more than compensated by a reduction of coal consumption (0.66 Mtoe over 18.8 Mtoe), with a corresponding reduction of 2.2 Mt of CO2 emissions (over 130 Mt CO2). Extra-costs (taking into account also investment and O&M costs) for this scenario are about 700 M€ in 2030, that corresponds to about 50 € for each MWh produced by the micro CHP plants.

Conclusions

The study shows that, from the system optimization (least overall costs) point of view, the current schemes and levels of subsidies incentivizing the development of RES can lead in 2030 to 133 TWh of "green" production over a potential of 151 TWh, thus providing a relevant contribution towards the compliance with the medium and long term targets set by the European Commission. Only photovoltaic solar and biogas sources remain far from their development potential under the modeled incentive schemes.

Moreover, dispersed generation based on micro CHP plants in the residential sector is not considered by the model a good option from the economic point of view, due to its high overall costs (forced installation would cause about 700 M€ of extra-costs). Nevertheless, its introduction would reduce both fossil fuels consumption by 0.47 Mtoe and CO_2 emissions by 2.2 Mt.

Future work will be aimed at defining and assessing the effects of new incentive schemes, characterized by subsidies differentiated for each RES generation technology, in order to optimize their effectiveness and possibly reducing their overall economic impact.