SECURE AND ECONOMIC INTEGRATION OF LARGE-SCALE DISTRIBUTED GENERATION TO THE GRID IN TURKEY

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Rationale & Objective

In 2006, 9% of installed capacity in Turkey is distributed generation (DG) which is connected to the low and medium voltage distribution network, out of this 56% is industrial CHP, 20% are renewables, mainly runoff small scale hydro. Various technical and economical barriers have kept the DG share relatively low. This paper assesses how Turkey could increase the DG share, also for renewables, in a secure and economic manner. This paper is based on the work conducted as part of the EU-funded DINEMO project under the title: "Distribution Networks Modernization Incentives in Pre-accession Countries" (http://www.bsrec.bg/newbsrec/dinemo/index.html).

Methodology

The methodology employed in this paper consist of a survey of the literature and legislation, combined with interviews with regulators, transmission and distribution system operators. From the collected information, the main barriers to increase the share of DG are identified, a comparative economic analysis between DG and central generation (CG) is performed and a regulatory action plan is formulated.

Studied Country

Turkey

Results

The main problem for a large scale integration of DG units is the primary focus on top-down balancing in Turkey. The distribution grid is designed to receive electricity and to pass it on to the consumers. The relatively weak distribution grid does not expect local production and is not designed to return the generated surplus back into the transmission grid in large quantities. Currently, planning is mainly demand-driven, where the interaction between transmission and distribution is considered as a restriction and where the share of DG at the distribution level is kept low by strict connection rules to avoid local balancing problems.

There is one load dispatching centre in Ankara providing instructions to all producers to balance the system and to provide ancillary services. While this is a proven method for managing frequency (active power), it is not the most effective way to deal with the local issues of voltage regulation (reactive power), harmonics and other ancillary services, especially when the share of DG is going to increase. The lack of measurement of electricity quality at the local level is also a major concern.

The main barriers to increase the share of DG in Turkey can be summarised as follows:

- There is no specific DG policy and regulation.
- The distribution grid is relatively weak in comparison to the to transmission grid.
- Lack of DG management experience by DSOs for balancing active power at the distribution grid.
- Investments in the transmission grid are to be undertaken by the TSO by law.

Important drivers for the comparison of costs for generators among generation technologies are capacity utilisation ratio (CUR), efficiency (η), fuel, operational and capital costs. Centrally generated NG, hydro and lignite respectively had a share of 41%, 24% and 18% in the total amount of generation in Turkey in 2006. Whereas wind, bio and geothermal contributed a mere 0.2% to the total amount of generation in Turkey in 2006.

Externalities like additional transmission and distribution (T&D) investment costs should be added to CG as compared to DG. The investment costs in the distribution network will be largely the same under any share of CG and DG. Moreover, the costs for back-

up services (stability, reserve, voltage regulation) of the system have to be incurred under any share of CG and DG. It is not clear a priori whether these costs are higher for a high share of DG, due to more decentralised balancing needs, or lower for a high share of DG, due to balancing the system at the distribution network, where lower levels of reserve capacity could suffice. The following figure presents the results in terms of long run marginal costs, including additional T&D investment costs for the situation in 2006.

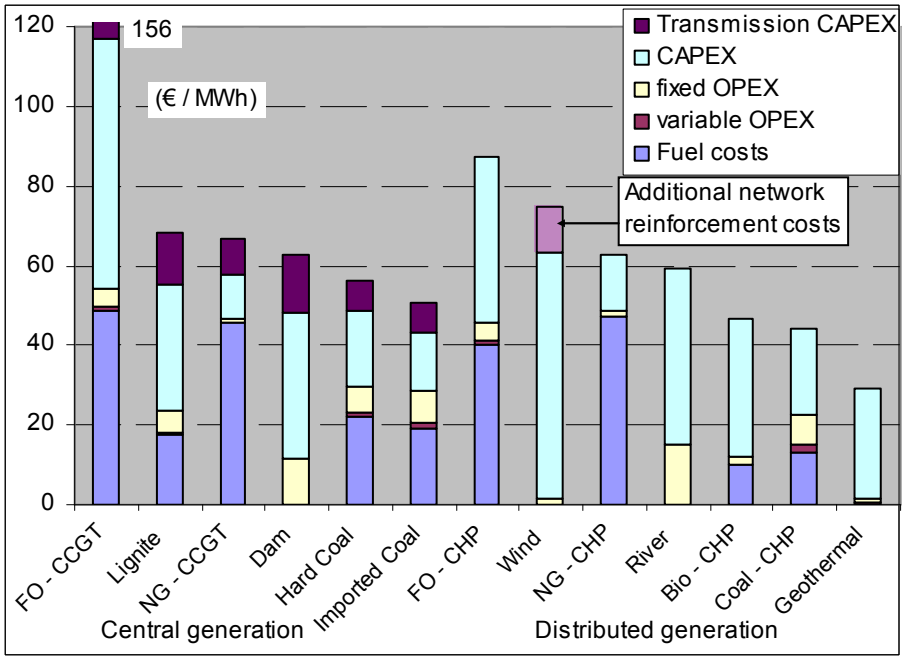

Figure 1 Cost comparison of generation technologies for the expected situation in 2006

Inspection of the figures show that the long run marginal costs are quite close for a number of technologies, except for the more expensive fuel oil, due to a low realised CUR. The comparison between distributed and central generation shows that NG – CCGT and lignite (low CUR in 2006) are more expensive than wind, NG – CHP and hydro from rivers, once T&D costs are included.

Conclusions

The solution to the problems in the distribution network which would emerge with a higher share of DG, which have come forward in this paper, is mainly to set up local dispatch centres and to strengthen the distribution grid, which would be able to respond timely to changing power conditions in the distribution grids. These local dispatch centres would extend the distribution network with measurement devices feeding into a communication system and investments in intelligent relay protection with control automation. As a result, ancillary services will be coordinated and provided locally. In some regions the possibility of island mode operation could be aimed at by installing sufficient back up capacities and storages to balance swings in intermittent resources and consumer demand in addition to central balancing.

An economic analyses comparing investments in CG and DG indicates that the cost advantage of CG over DG disappears, once the additional costs for transmission services are taken into account. This economic analysis provides an important motivation for investors, regulators and the Ministry of Energy and Natural Resources (MENR) to consider DG technologies as a serious and attractive alternative to CG technologies and to prepare for managing the distribution networks actively.

From a regulatory point of view, supporting regulation is required to overcome the earlier defined barriers:

- Issuing a regulation specifically for DG, so that the issue of DG is set on the policy agenda
- Issuing a regulation for strengthening the distribution grid, also pointing out the rules for investment funds.
- Issuing a regulation to set up local dispatch centres and train distribution grid managers in balancing at the local level.
- Internalising externalities.