ECONOMIC ASSESSMENT OF ACTIVE DG GRID INTEGRATION - AN AUSTRIAN CASE STUDY

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(1) Overview

The share of renewable energy sources in the Austrian generation mix has traditionally been high due to the availability of hydro power in many regions of the country. Nevertheless, a strong rise in the amount of distributed generation (DG) is expected for the coming years as a result of CO_2 reduction policies and sustainability considerations within the European Community (for details see Directive 2001/77/EC) and Austria. The current planning and operation approaches of medium voltage (MV) grids do not allow for integration of the required amount of additional DG in many cases, leading to severe voltage problems as more and more generators are connected to the grid (compare Degner et al, 2006). In the frame of the Austrian research project "DG DemoNet"[1], three MV grid segments have been studied in detail focusing on innovative technical solutions for DG integration which possibly avoid extensive grid investments.

(2) Methods

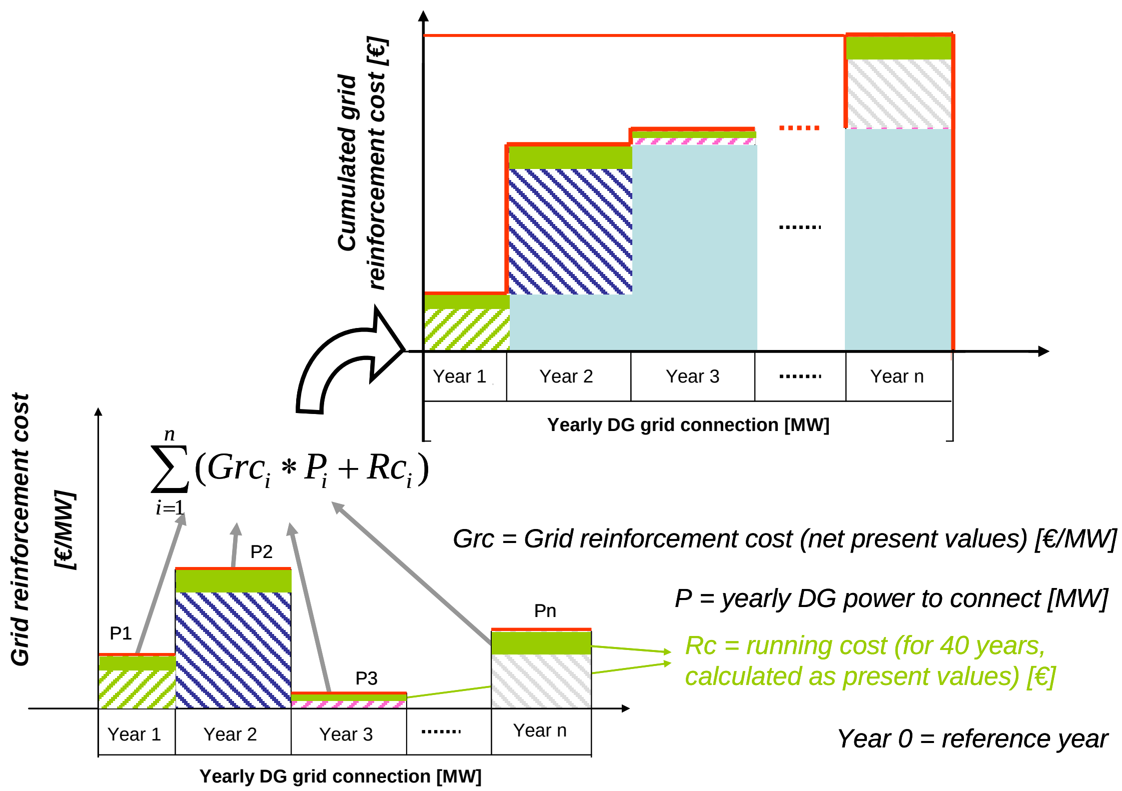

Fig. 1: Evaluation of case specific cost for grid reinforcement measures (net present values)

[1] This project is carried out and financed within the scope of the Austrian Program on Technologies for Sustainable Development, "Energy systems of tomorrow" – a cooperation of the Austrian Federal Ministry of Transport, Innovation and Technology and the Austrian Research Promotion Agency (FFG).

The technical and economical results of DG grid integration within specific Austrian case study regions are derived in the following way:

- The current state of the grid segment and its inability to host even higher shares of DG is analysed. This bottleneck is enlarged by virtually connecting several new DG units into the grid segment. Therefore achievable renewable generation potentials have been estimated by the Distribution System Operators (DSOs).
- Furthermore, technical solutions (with focus on active grid operation) to overcome this problem without reinforcing the grid are developed.
- Next, the cost evaluation strategy indicated in Figure 1 cumulates yearly grid reinforcement cost (net present values) as well as incurring running cost (calculated and subsumed as present values for the year of construction)
- Finally, the economic results of active DG solutions are compared to conventional strategies.

(3) Results

An overview on DG grid integration cost (cumulated net present values) depending on the grid integration strategy is given for selected case study regions in Austria. Furthermore, detailed economic analysis for different grid- as well as producer-driven strategies (e.g. local vs. coordinated voltage control) for voltage regulation approaches (for a detailed technical description compare Kupzog et al., 2007) are derived.

These strategies are compared to a conventional reference grid reinforcement solution enabling the grid change e.g. through cable replacements. The comparison shows that the cost for the newly developed active DG grid integration solutions are about 50% lower compared to the reference case. It has to be mentioned that this strongly depends on the existing grid infrastructure utilisation (stronger designed grids have higher reserves to integrate DG than weaker ones) as well as on the chosen grid segment[2] itself and therefore can not be generalised.

(4) Conclusions

The project results (based on extensive power flow simulations within the DIgSILENT PowerFactory® software) indicate that new and more active DG grid integration approaches are both technically feasible and competitive compared to the reference scenario. The analysis derived implies further that investments in new smart grid technologies may even lead to lower overall cost for society, if a suitable grid structure can be identified in advance.

References

Directive 2001/77/EC of the European parliament and council on the promotion of the electricity produced from renewable energy source in the internal electricity market

Friederich Kupzog, Helfried Brunner, Wolfgang Prüggler, Tomaz Pfajfar (2007): „DG DemoNet-Concept - A new Algorithm for active Distribution Grid Operation facilitating high DG penetration"; Proceedings 5th International Conference on Industrial Informatics (INDIN2007), Vienna, 2007

Thomas Degner, Jürgen Schmid, Philipp Strauss (2006): „DISPOWER – Distributed Generation with High Penetration of Renewable Energy Sources", Final Project Report p. 15 - 17, Contract No. ENK-CT-2001-00522; Kassel, 2006

[2] Within the project all virtually added DG units where integrated in only one branch circuit; therefore further research will focus on a more general approach.