Renewable and Sustainable Energy Reviews 59 (2016) 1130–1148

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

journal homepage: www.elsevier.com/locate/rser

Distributed generation: A review of factors that can contribute most to achieve a scenario of DG units embedded in the new distribution networks

Antonio Colmenar-Santos*, Cipriano Reino-Rio, David Borge-Diez, Eduardo Collado-Fernández

Industrial Engineering Higher Technical School, Spanish University for Distance Education (UNED), Juan del Rosal St., 12-28040 Madrid, Spain

ARTICLE INFO

Article history:
Received 2 September 2014
Received in revised form
23 September 2015
Accepted 7 January 2016

Keywords:
Distributed generation
Active Management Network
Information
Communication and Control Technologies
Hybrid systems
EV
Multiobjective planning

ABSTRACT

We are witnessing in recent years a significant increase in the penetration of small units of distributed generation on electricity networks, motivated by a higher demand of environmental protection and a gradual process of liberalization on the energy market. In last decade many countries have begun a liberalization process of their electrical systems by opening access to transmission and distribution networks. This has been accompanied by a fast growth in the presence of small generators distributed, of several technologies, many of them based on renewable energy sources.

However, there are still technical, economic and regulatory barriers that limit the definitive boost of distributed generation (DG). The increase of connections in many cases, has been based on the philosophy "fit and forget" and capacity of installed DG remains limited by Distribution Network Operators. In this article are reviewed those factors that can contribute most to the necessary evolution of DG, to overcome the current paradigm of renewable distributed generation sources "integrated in a real network", and reach a stage of DG units "embedded in the new distribution networks".

To do this, aspects such as, Smartgrids and new information and communications technologies, microgeneration and storage technologies, Active Management Network, multiobjetive planning as an optimization tool for sizing and selection of sites DG, or regulatory issues, are examined along of this article.

© 2016 Elsevier Ltd. All rights reserved.

Contents

Abbreviations: DG, Distributed generation; SG, SmartGrid; CHP, Combined Heat and Power; FACTS, Flexible Alternating Current Transmission Systems; ICCT, Information, Communications and Control Technologies; SCADA, Supervisory Control and Data Acquisition; AMN, Active Management Network; DNO, Distribution Network Operator; EV, Electric vehicle; HDGS, Hybrid Distributed Generation Systems; MG, Microgrid; GC, Generation curtailment; OLTC, On-load-tap-changer; MCS, Monte Carlo Simulation; RPC, Reactive power compensation; AVC, Automatic Voltage Control; DMSC, Distribution Management System Controller; OPF, Optimal Power Flow; FCM, Fuzzy C-Means Clustering Algorithm; EA, Evolutionary Algorithms; MOEA, Multiobjetive Evolutionary Algorithm; NSGA-II, Non-Sorting Genetic Algorithm II; SPEA2, Strength Pareto Evolutionary Algorithm II; GA, Genetic Algorithm; MTLBO, Modified Teaching-Learning Based Optimization

* Corresponding author. Tel.: +34 913 987 788; fax: +34 913 986 028.
E-mail addresses: acolmenar@ieec.uned.es (A. Colmenar-Santos), creinor@mundo-r.com (C. Reino-Rio), archeop@gmail.com (D. Borge-Diez), ecollado@ieec.uned.es (E. Collado-Fernández).

http://dx.doi.org/10.1016/j.rser.2016.01.023
1364-0321/© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

According to the estimations of the U.S. Energy Information Administration [1] it is expected an electricity generation increase by 93% during the period 2010–2040, and that grow will happens at a rate significantly higher than global energy consumption (Fig. 1). Renewable energy sources will contribute greatly to the power generation mix with an estimated growth for that period of 2.8% per annum, to achieve a weight of 24% of total power generation in the year 2040 (Fig. 2).

In the past few years, as a result of the beginning of liberation processes in electrical systems, the growing of environmental concern of the society and as a result of the rise of renewable energy production, changes have been happening that affect the forms of power generation and to the own transmission and distribution networks. Among them, it highlights the growth that is experiencing DG [2,3], which expects a growth of 183% of the installed power for the period between 2009 and 2016 (Fig. 3).

Unlike what happens with conventional electrical networks, which have generation units with power comprised between 100 MW and 1 GW and in which power flow is unidirectional, DG implies the proliferation of small generation units (from 1 kW to 1 MW) connected to distribution network and nearby to final customers, in which power flow can be bidirectional [4,5].

DG, and especially where systems are based on renewable sources, has both technical, economic and environmental advantages [5–8], as shown in Table 1. From a technical point of view DG allows to reduce power losses, improve voltage profiles, to increase the power quality or improve energy efficiency with the use of CHP units (Combined Heat and Power). Within the economic advantages it should be noted the reduction in operating costs of transmission and distribution networks, the reduction of environmental costs or reduction of electricity tariff.

Also, a large-scale use of renewable distributed energy sources will reduce the consumption of fossil fuels, the greenhouse gas emissions (Water Vapor, H_2O; Carbon dioxide, CO_2), emissions or another gases (SO_2), and will help to reduce noise pollution [9].

The increase of penetration of DG can also generate technical problems in networks, such as a greater difficulty in voltage control, the management of the reactive power, a reduction in the effectiveness of electrical protections, a negative impact on the quality power, or even reliability and stability problems. One of the most important aspects that limits a greater proliferation of DG units in existing networks is the control of allowable voltages levels in the nodes [6,7].

Although implementation of DG can provide economic, technical and environmental benefits, it is important to solve adequately the problem of optimal sizing and location of DG units. There are a lot of examples in the literature that have studied the optimal location for DG under certain objectives and constraints [10–19]. However, the systematic principle to tackle this task is still a problem not resolved definitively. The election has been based in the solution of an optimal planning problem, in which the optimization of technical (minimization of losses, improvement of voltage profiles, reduction of power flows) and economic objectives is chased.

Despite the experienced growth of DG systems in recent years, there are still certain barriers (technical, economic, regulatory) that restrict progress toward a new model of electric networks. This article proposes a review of those factors that can contribute to the definitive takeoff of the integration of DG. In Section 2 is

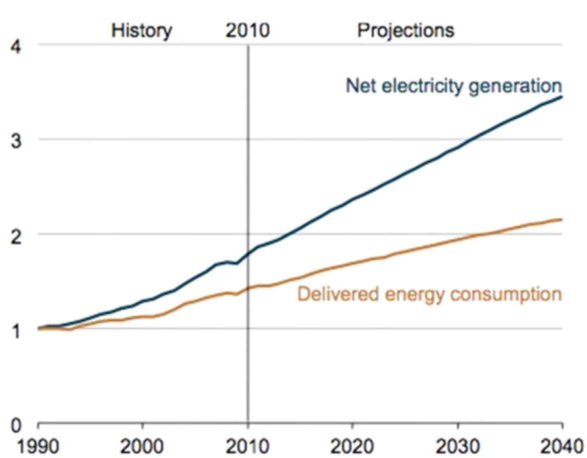

Fig. 1. Evolution global generation of electricity, and global consumption of energy, 1990–2040 (index 1990 = 1) [1].

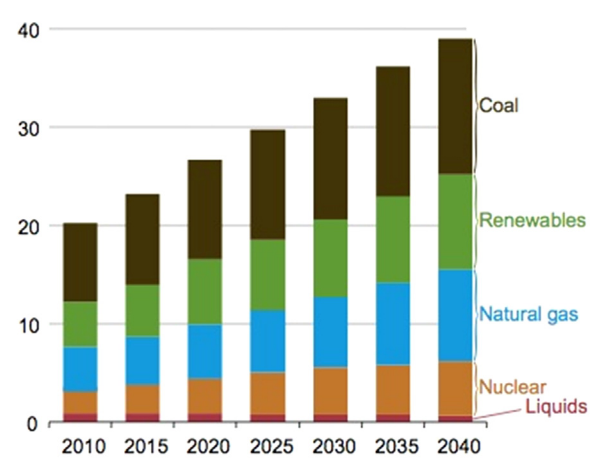

Fig. 2. Evolution of global electricity generation by sources of energy (in trillion kW h) [1].

Download English Version:

https://daneshyari.com/en/article/8114482

Download Persian Version:

https://daneshyari.com/article/8114482

Daneshyari.com