Current tendencies in the integration of renewable resources And modeling of wind energy systems

(State of the art, GIS Prospection, modeling and optimization methodologies)

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Summary

ABSTRACT

This paper has as an objective of presenting the current tendencies in the modelling and integration methodologies of some renewable resources, specifically applied for wind resources. Describes also some, but not all the popular state of the art methodologies used in prospecting, modelling, optimizing the integration of wind renewable energy systems.

Elevated degree of progress had been attained in wind resource assessment methodologies as well as the different approaches of wind energy modelling. This paper has methodological value for all who want to start working with the wind resource assessment methodologies, giving an insight about the different commonly used approaches to manage wind energy resource assessment and system integration issues.

INTRODUCTION

The paper discuses the basic reasons of the renewable energies especially; wind energy limitations on the penetration aspects in the energy market. Also explains the strategic approach that has to be followed to increase the integration of this renewable resource to the dynamic electrical energy market. There are exemplary approaches mentioned from optimization perspective; from surveying the best RE sitting to harvest the maximum energy at competitive unit cost and to build robust prediction systems to minimize uncertainty problems. Both issues are as equally important as but unfortunately contrary.

Therefore, it is depicted the whole effort made towards the improvement of the confidence level for effective RE competitiveness. Where, there are described different currently applied methodologies for WRA and optimization operations. Although a continuous straggle is made to minimize the degree of uncertainties of WRA besides to this fact; the dynamics of environmental set has put serious limitations in to it, due to stochastic nature.

This paper is intended to describe the state of the art of current wind RE prospecting, wind modeling and optimization tools applied to integrated renewable energy systems. Finally the main objective is to show the degree of progresses in developing methodologies for integrated renewable resources using state of art tools.

Key words: Prospecting, Optimization, Integration, Model

Nomenclatures: RER –Renewable Energy Resources, NWP-Numeric weather prediction, DSM-Demand Side Management, MCP-Measure Correlate Predict, WRA- Wind resource Assessment

Even the modest-scale integration of renewable energy resources at minimum integration costs requires research in three main areas:

A-RER, prospection, optimum sitting and capability assessment

B-Dynamic Renewable Energy models

C-Additional possibilities for decision flexibility

The above stated components have strategic relevance for the integration of wind energy. In this paper it will be discussed about currently used prospecting tools, models, and prediction and optimization tools.

Wind has three major classes of origin: primary, secondary and tertiary. The primary or global origin of wind resource in a simpler form, four atmospheric forces: pressure force, Coriolis force (due to earth rotation), inertial force (due to global scale circular motion) and frictional forces (with the earth's surface) determine the global perspective of wind motion. Secondary sources of wind include hurricanes, monsoon circulation and cyclones. Thirdly, diurnal variations, thunderstorms, tornadoes etc. determine short-term, small-scale wind variations.

One of the primary goals of wind energy site assessment is the estimation of long-term wind energy at a potential site. These include the utilization of wind maps or atlases, reanalysis software's or mesoscale modelling etc.

The ideal site assessment method should result in an overall reduction in the uncertainty of the estimate of the long-term wind resource, rapidity of the site assessment, and minimized cost implications even tough; different assessment methods yield a wide range of excellence in their exhaustiveness. Comparison between the degrees of uncertainty for average annual wind speed using different methodologies is summarized in tabulated form.
Also simple suggestion for researchers to select the WRA methodology, taking in to consideration their economic importance and degree of complexity is included in form of bottom-up diagram.