



Wind resource assessment in the state of Arizona: Inventory, capacity factor, and cost

Thomas L. Acker^a, Susan K. Williams^{b,*}, Earl P.N. Duque^a,
Grant Brummels^c, Jason Buechler^a

^a*Mechanical Engineering, PO Box 15066, Northern Arizona University, Flagstaff, AZ 86011, USA*

^b*College of Business Administration, PO Box 15066, Northern Arizona University, Flagstaff, AZ 86011, USA*

^c*Sustainable Energy Solutions, PO Box 15066, Northern Arizona University, Flagstaff, AZ 86011, USA*

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Abstract

During the summer of 2003, the state of Arizona took delivery of a set of high-resolution wind energy maps that were developed with a meso-scale wind energy model coupled with wind data. The geographical information system data supplied with the wind maps was used to create a wind resource inventory that included wind energy potential, proximity to transmission lines, and land ownership. Four diverse sites were selected for further study, one predominantly class 3, one predominantly class 4, one predominantly class 5, and one predominantly class 6. At each site, the capacity factor was determined, the seasonal influence was observed, and the real levelized cost of energy in 2005 dollars determined. As the wind class varied from 6 to 3 the levelized cost of energy ranged from 4.22 to 6.00 cents/kWh. These results do not include the production tax credit or the renewable energy production incentive, do include adjustments for elevation, losses, and inflation, and are considered conservative. This paper documents the findings of the wind mapping process, describes the method and results of evaluating the most promising sites for wind development, and presents the cost of energy results.

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*Corresponding author. Tel.: +1 928 523 0940; fax: +1 928 523 7331.

E-mail address: sk.williams@nau.edu (S.K. Williams).

1. Introduction

In 2002 Arizona produced over 94,000,000 MWh of electricity with 62,600,000 MWh of in-state sales. Currently, Arizona is an exporter of electricity. The demand for electricity has been increasing in the state of Arizona at an average of 3.9% annually from 1993 to 2002. Generation capacity has been increasing but at a lower rate of 2.8% during that same time period [1].

In March 2006, the Arizona Corporation Commission (ACC) proposed a new renewable portfolio standard (RPS) [2]. This new standard requires an increasing percentage of energy be generated by renewable energy sources so that by 2025, 15% of electricity will be generated from renewable resources. This is a significant increase from the 2001 standard of 1.1% by 2007. In addition, utilities will be annually graded on their contribution to this goal with the commissioners discussing possible penalties if utilities are not adequately contributing [3]. Currently less than 1% of electricity is generated from renewable resources [1] (see Fig. 1), so there is significant need for future wind and renewable energy development.

Arizona has an enviable solar resource with an average of 300 sunny days a year. However, since current photovoltaic energy costs are estimated to be \$0.15–\$0.25/kWh, there will likely be more development of wind, geothermal and biomass until solar costs further decline [4]. The cost of wind energy has decreased significantly. In the 1990s, the cost of wind turbines declined approximately 20% every time production doubled, which occurred every 3 years. This made wind energy the fastest growing energy technology in the 1990s [5]. While Arizona is not in the top 20 US states for wind resource [6] it does have a wind resource capable of supporting utility-scale development. “The larger contiguous areas of good-to-excellent resource are located in northern and eastern Arizona close to the eastern edge of the Mogollon Rim. Good-to-excellent wind resources are also found on the higher rims and ridge crests throughout the state [7].”

2002 Percentage Electricity Generation in Arizona

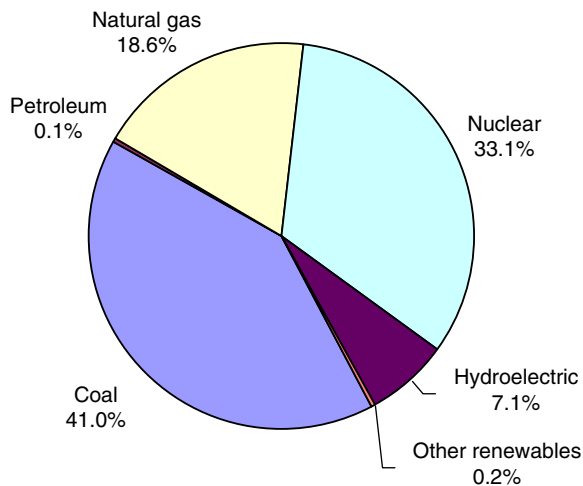


Fig. 1. Arizona electricity generation by energy source 2002.

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