Renewable and Sustainable Energy Reviews 52 (2015) 523–533

Contents lists available at ScienceDirect

Renewable and Sustainable Energy Reviews

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

Costs and benefits of renewables portfolio standards in the United States

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ARTICLE INFO

Article history:
Received 22 January 2015
Received in revised form
28 July 2015
Accepted 29 July 2015
Available online 25 August 2015

Keywords:
Renewable portfolio standard
Costs and benefits analysis
Cost caps
Renewable energy certificates

ABSTRACT

Most state renewables portfolio standard (RPS) policies in the United States have five or more years of implementation experience. Understanding the costs and benefits of these policies is essential for RPS administrators tasked with implementation and for policymakers evaluating changes to existing or development of new RPS policies. This study estimates and summarizes historical RPS costs and benefits, and provides a critical examination of cost and benefit estimation methods used by utilities and regulators. We find that RPS compliance costs constituted less than 2% of average retail rates in most U.S. states over the 2010–2013 period, although substantial variation exists, both from year-to-year and across states. Compared to RPS costs, relatively few states have undertaken detailed estimates of broader societal benefits of RPS programs, and then only for a subset of potential impacts, typically some combination of avoided emissions and human health benefits, economic development impacts, and wholesale electricity market price reductions. Although direct comparison to RPS cost estimates is not possible, the available studies of broader RPS benefits suggest that in many cases these impacts may at least be of the same order of magnitude as costs, highlighting a need for more refined analysis.

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http://dx.doi.org/10.1016/j.rser.2015.07.175
1364-0321/

1. Introduction

Renewables portfolio standards (RPS) require electricity providers to obtain specific amounts of renewable energy generation over time and are prevalent within the United States. In total, 29 U.S. states plus Washington DC have adopted some form of mandatory RPS requirement, with most policies enacted during the latter half of the 1990s and 2000s. Roughly 51 GW or two-thirds of all non-hydroelectric renewable capacity additions from 1998 through 2013 occurred in states with active or impending RPS targets, suggesting that these policies – alongside other state and federal policies and voluntary renewable energy markets – have played an important role in driving U.S. renewable electricity growth.[1]

With the proliferation of RPS programs has come renewed interest in understanding their costs and benefits. In recent years, this interest has frequently manifest within the context of legislative proposals to repeal or roll-back existing RPS programs, often on the basis that the policies impose undue burdens on utility ratepayers [7]. Aside from these politically charged debates, information about RPS costs is often needed as part of routine administrative and reporting functions. In particular, utilities or regulators are often required to estimate RPS compliance costs annually in order to fulfill statutory reporting requirements, to develop surcharges used to recover RPS-related costs, or to ensure that utilities do not exceed statutory cost caps [8] and [9]. Occasionally, states have also undertaken more expansive cost-benefit analyses, either on a prospective basis to inform the development of new RPS policies or, less frequently, on a retrospective basis to evaluate existing programs and inform possible revisions.

Estimating RPS costs and benefits entails a wide variety of methodological issues. In some states, certain aspects of the cost calculation methodology may be specified in statute or in implementing rules issued by the public utility commission (PUC), and a number of states (e.g., New Mexico, Minnesota, Washington) have recently conducted or initiated regulatory proceedings to develop consistent RPS cost calculation methods across utilities. In general, RPS cost estimates developed by utilities and regulators represent a net cost, accounting for avoided costs of displaced conventional generation. RPS programs, however, may also yield other forms of benefits or broader societal impacts, such as avoided air pollutant emissions, human health effects, reduced water consumption, fuel diversity, economic development, and electricity price stability. These broader benefits and impacts typically are not included within routine state or utility analyses, though they may be contained within occasional broader evaluations.

This article summarizes state-level RPS costs to date – drawing in part on original analysis and in part on a synthesis of estimates developed by utilities and regulators – and considers how those costs may evolve going forward given scheduled increases in RPS targets and cost containment mechanisms incorporated into existing policies. In doing so, the article seeks to provide a reasonably comprehensive empirical benchmark for gauging the costs of these important policies, and highlights key methodological issues critical to interpreting and refining cost estimates going forward. In addition, the article synthesizes available analyses of broader social benefits or impacts of state RPS programs, including emission and human health impacts, economic development, and wholesale electricity market price suppression – though, for a variety of reasons, the results of those studies are not directly compared to RPS cost estimates.

[1] A variety of other analyses – including Carley [1], Delmas and Montes-Sancho [2], Eastin [3], Shrimali and Kniefel [4], Yin and Powers [5], and Zhao et al. [6] – have sought to estimate the effects of RPS policies on renewable generation using econometric or other more-sophisticated means, and have found varied impacts, depending on the methods, scope, and timeframe of their analyses.

2. Methods

This analysis adds to a relatively small, but varied, literature analyzing RPS costs across states. At the national level, cost impacts of a proposed federal RPS have been studied with the use of modeling tools [10–12]. At the state level, Morey and Kirsch [13] use regression analysis to examine the impact of various policies, including an RPS, on electricity rates, using historical data. Chen et al. [14] examined prospective, rather than retrospective, RPS studies, many of which were funded by nongovernmental organizations and were conducted to inform new RPS policies that were then under consideration.

2.1. RPS costs

We estimate *incremental* RPS costs – that is, the net cost to the utility or other load-serving entity (LSE) above and beyond what would have been borne absent the RPS – during the period 2010–2013. We describe RPS compliance costs in terms of two metrics, though focus our discussion of results primarily on the second:

- *Dollars per megawatt-hour of renewable energy required or procured*, representing the average incremental cost of RPS resources relative to conventional generation;
- *Percentage of average retail electricity rates*, representing the dollar magnitude of incremental RPS costs relative to the total cost of retail electricity service (generation, transmission, and distribution).

In general, our RPS cost-calculation methods depend on the structure of the state's retail electricity market. In particular, for states with competitive retail electricity markets (herein termed "restructured" states), we generally estimate RPS compliance costs based on the cost of renewable energy certificates (RECs) and alternative compliance payments (ACPs). For states with traditional regulated, monopoly retail electricity markets, we instead synthesize RPS compliance cost estimates published by utilities and regulators, and highlight key methodological variations. Further details on the data sources and methods used to compute incremental RPS costs are provided below, with additional information in Heeter et al. [15].

2.1.1. States with restructured markets

Load serving entities (LSEs) in restructured markets typically meet RPS requirements by purchasing and retiring RECs, which represent the renewable energy attribute – in effect, the renewable energy premium above conventional power. RECs can be, and often are, transacted separately from the underlying electricity commodity. Moreover, because LSEs in restructured markets typically do not have long-term certainty regarding their load obligations, they often purchase RECs primarily through short-term transactions, although longer-term (10- to 20-year) contracting has become more prevalent recently, in order to improve the financeability of renewable generation projects. Most states with restructured markets include an ACP mechanism whereby an LSE may alternatively meet its obligations by paying the program administrator an amount determined by multiplying the LSE's shortfall by a specified ACP price (e.g., $50/MWh). ACP prices serve, more or less, as a cap on REC prices, because LSEs generally would not pay more than the ACP rate for RECs.

Many RPS policies divide the overall RPS target into multiple resource tiers or classes, each with an associated percentage target. These often consist of some combination of a "main tier" for those resources deemed to be most preferred or most in need of support (e.g., new wind, solar, geothermal, biomass, small