UCS State Green Banks Analysis

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Appendix: Quantitative Methodology Description

Union of Concerned Scientists

Model Overview

The Union of Concerned Scientists (UCS) retained Meister Consultants Group (MCG), an international energy-policy consulting firm, to develop a spreadsheet model for quantifying the impact of hypothetical green banks in Maine, New Hampshire, and Vermont. This model updates a previous version designed to analyze potential green bank impacts in Michigan, Pennsylvania, and Virginia.

MCG used the model to calculate the levels of solar energy, wind energy, and energy efficiency that could reasonably be developed over a 15-year period with the assistance of green-bank lending in Maine, New Hampshire, and Vermont. MCG also used the model to determine the carbon emissions reductions achieved through such investments and the savings on consumer electricity bills from energy efficiency improvements. The model inputs were based on the experiences of states that have developed green banks, primarily New York and Connecticut.

This three-state analysis complements the 2015 UCS publication *Financing Clean Energy: Cost-Effective Tools for State Compliance with the Clean Power Plan* (Belden, Clemmer, and Wright 2015).

Methodology

MCG first determined the appropriate initial capitalization amount to assume for a hypothetical green bank in each state. It then distributed that amount across five to six clean-energy-resource categories (residential efficiency, nonresidential efficiency, land-based wind, residential solar, commercial solar, and utility solar). The allocation to these different categories varied somewhat by state.

As described below, the green bank's annual allocation would be paid out to energy efficiency and renewable energy projects with an assumed interest rate of 5 percent, a term of seven years for efficiency projects and 10 years for renewables projects, and a leverage ratio of five private-sector dollars for every one green bank dollar. Each year's loan payments were added to the next year's allocation from the initial capitalization and redispersed to the market on a revolving basis. After the initial capitalization was spent down, only the previous year's loan payments would be dispersed.

From this cycle, MCG calculated the amount of resulting energy resources (measured in terms of installed capacity and generation for renewable energy projects and in terms of electricity savings and peak reductions for energy efficiency projects). MCG also calculated a corresponding value for carbon emissions reduction, both on an annual and cumulative basis, and it estimated savings on consumer electricity bills due to investments in energy efficiency.

Data Sources

MCG utilized the following data sources and inputs in its green bank model.

FINANCIAL INPUTS

Initial capitalization. This variable reflected the capitalization of the New York Green Bank ($210.3 million or $10.65 per capita) (Rhodes, Bloustein, and Pitkin 2013), scaled for each of the three states on a per-capita basis and rounded to the nearest million dollars. The resulting amounts for initial capitalization were $14 million for Maine, $14 million for New Hampshire, and $7 million for Vermont. For comparison, Connecticut's initial capitalization of $48 million was slightly higher on a per-capita basis ($13.35) than New York's.

Initial capital allocation period. To ensure that investments were made in a steady manner, MCG assumed that the initial capital would be allocated over a period of 10 years, matching the maximum term of green bank loans.

Capitalization interest rate. During the initial capital allocation period, MCG conservatively estimated that the fund would accrue interest at the one-year Treasury bill rate of 0.36 percent (DoT 2015).

Allocation of funds by technology. The allocation of funds varied by state. For Vermont, which has made substantial investments in energy efficiency, MCG assumed that 40 percent of the fund would be dedicated to energy efficiency investments (split evenly between the residential and nonresidential sectors), 50 percent to solar photovoltaics (split among the residential, commercial, and utility sectors), and 10 percent to community wind projects. The clean energy investments in Vermont are roughly consistent with the electricity-related allocation included in a 2016 Energy Action Network study of the investments needed to achieve the state's long-term goal of meeting 90 percent of total energy use by 2050 with renewables and efficiency (Energy Action Network 2016). For Maine and New Hampshire, MCG assumed that 50 percent of the fund would be dedicated to energy efficiency investments (split evenly between the residential and nonresidential sectors), 40 percent to solar photovoltaics (split evenly among the residential and commercial sectors), and 10 percent to community wind projects. While the model includes the option of financing offshore wind projects in Maine, MCG did not assume the green bank would be used in this way, given limited funds.

Private investment leverage ratios. Existing state green banks have leveraged between five and 10 private dollars for each green-bank dollar spent (Belden, Clemmer, and Wright 2015; GCCRUC 2015). Using recent and forthcoming data from the Connecticut and New York Green Banks, a ratio of five private sector dollars per green bank dollar was selected as the leverage ratio, applied to all technologies (Shrago and Healey 2016; Connecticut Green Bank 2016; NY Green Bank 2016).

Borrower interest rate. Based on the experience of the Connecticut Green Bank (Energize Connecticut 2014a, 2014b, 2013), MCG assumed a 5 percent borrower interest rate for all states and technologies.

Debt tenor. Based on a review of energy efficiency and renewable energy lending efforts nationwide, MCG assumed that efficiency loans would have a term of seven years and renewable energy 10 years.

Period of analysis. The analysis considered the impacts of green bank investments over a period of 15 years, beginning in 2017 and ending in 2031.

Federal tax credits. MCG included the December 2015 five-year extension of federal tax credits for wind and solar, which has the effect of allowing green bank funding to leverage additional investments in and development of these technologies. MCG also assumed that utility-scale wind and solar projects would take advantage of the "commence construction" provision, effectively extending the value and ramp-down rates of the tax credits by three years.

TECHNOLOGY-SPECIFIC INPUTS

Renewable energy capital costs. Wind and solar capital-cost inputs were sourced from the National Renewable Energy Laboratory's 2016 Annual Technology Baseline, using the Regional Energy Deployment System (ReEDS) (NREL 2016). The ReEDS model includes state-specific projections for capital costs, with annual cost reductions through 2031 for wind energy, utility-scale solar photovoltaics (PV), and distributed residential and commercial solar PV. Wind capital costs were based on the mid-case assumptions developed for the 2015 DOE Wind Vision Study (DOE 2015a). Solar capital-cost projections were based on mid-case assumptions from a literature review by NREL that served as an update to projections from the DOE Sunshot initiative (Feldman et al. 2015).

Renewable energy capacity factors. The model included wind-energy capacity factors for both land-based and offshore wind, which escalate annually with technology improvements (rising from 38.8 percent in 2016 to 45.0 percent in 2035 for land-based wind, from 35.0 percent to 38.0 percent for shallow offshore wind, and from 47.0 percent to 51.0 percent for deep offshore wind).

These values, representative of a Class 3 or 4 wind site, were based on assumptions used in the DOE Wind Vision Study (DOE 2015b). MCG used utility-scale solar capacity factors of 17.7 percent for Maine, 17.5 percent for New Hampshire, and 17.4 percent for Vermont, sourced from the ReEDS model. Residential and commercial solar-capacity factors were calculated from the NREL PVwatts model (NREL 2015), using location data from the Portland International Airport for Maine (15.1 percent), Concord Municipal Airport for New Hampshire (14.4 percent), and Burlington International Airport for Vermont (13.9 percent).

Energy efficiency capital costs. The model utilized cost estimates from the American Council for an Energy-Efficient Economy (ACEEE) (Hayes et al. 2014) that start at $0.28 per kilowatt hour (kWh) in 2016 and gradually increase to $0.52 per kWh in 2021, reflecting the assumption that the lowest-cost efficiency interventions will be attempted first. These estimates reflect the full cost of energy efficiency measures, including both participant costs and any utility or state incentives, but not the administration costs for an energy efficiency program. To allow for a smooth change in the cost of efficiency interventions, this analysis differed from the ACEEE's in that MCG assumed costs would ramp up gradually from 2016 to 2021, rather than step up instantaneously in that year.

Energy efficiency peak reductions. EIA Form 861 data (2014 early release) (EIA 2015) were used to estimate the utility peak reduction associated with a given level of energy efficiency savings. Due to limitations of the available data, MCG calculated the ratio of energy savings to peak demand reduction on a national basis but separately for residential and nonresidential efficiency programs. For residential efficiency measures, each MW of peak reduction was calculated as corresponding to 3,825 MWh of energy savings; for nonresidential energy efficiency, each MW of reduced peak corresponded to 4,109 MWh of energy savings.

Energy efficiency measure lives. MCG adjusted cumulative energy efficiency impacts to account for the expected measure life of energy efficiency investments. Per ACEEE (Molina and Neubauer 2014), residential energy efficiency measures have a weighted-average expected useful life of eight years and nonresidential energy efficiency measures an expected useful life of 12.5 years (conservatively rounded down to 12 years). For simplicity, these average measure lives were respectively applied to all residential and nonresidential energy efficiency investments. It was further assumed that all renewable energy investments would continue to generate electricity throughout the 15-year period of analysis.

Value of efficiency savings. MCG calculated the dollar value of 2030 energy efficiency savings using the 2015 average retail electricity rate for each state available from the Energy Information Administration (EIA 2016). To be conservative, no escalation factor was applied to retail rates. For simplicity, flat or demand-based bill components were not considered.

Percentage of 2013 consumption. MCG calculated 2030 electricity generation and savings as a percentage of 2015 retail sales in each state, using EIA data (EIA 2016).

AVOIDED CARBON EMISSIONS INPUTS

Emissions rate. To calculate the avoided carbon emissions resulting from green bank investments, MCG used the EPA's Clean Power Plan's average emissions rates for each state (EPA 2015). For modeling simplicity, MCG assumed that energy efficiency savings and renewable energy generation would offset carbon emissions at a rate equal to the current average emissions rate of fossil-based electricity generation in each state. These rates were 873 pounds per Megawatt hour (lbs/MWh) for Maine and 1,119 lbs/MWh for New Hampshire. As there are no utility-scale fossil fuel generators in Vermont, the EPA has not calculated an emissions rate for that state for Clean Power Plan purposes. Instead, MCG used 2014 regional emission rates for emitting locational marginal units of 1,107 lbs/MWh to estimate emission reductions in Vermont based on data from the Independent System Operator of New England (ISO-NE 2016).

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