Economic Analysis of Ohio's Renewable and Energy Efficiency Standards

Ohio State Researchers Find Ohio's Renewable and Energy Efficiency Standards Have Saved Ratepayers 1.4% Since Inception, and Weakening of the Standards Will Result in Higher Energy Bills, Fewer Jobs and Increased Emissions over the Coming Decade.

September 25, 2013

Ohio Senate Bill 221 (SB 221), which became law in 2008, includes provisions for renewable energy and efficiency improvements. To better understand the economic implications of these provisions, Advanced Energy Economy Ohio Institute[1] (AEEOI) engaged The Center for Resilience[2] at The Ohio State University (OSU) to perform an energy-economic modeling study, resulting in estimates of the economic, environmental, and social benefits associated with this legislation.

OSU has analyzed the following two alternative scenarios, one retrospective and the other prospective:

- **Retrospective "fallback" scenario**: What if SB 221 had not been implemented in 2008?

  If SB 221 had not been implemented, we estimate that Ohio's statewide energy demand, electricity costs and carbon dioxide (CO_2) emissions would all have been about 2% higher by 2012. Despite a slight increase in generation costs, **SB 221 resulted in a 1.4% reduction in Ohio electricity bills.** In addition, increased investments in the energy sector stimulated GDP by $160 million in 2012, and created over 3,200 Ohio jobs in the period from 2008 to 2012.

- **Prospective "modified" scenario**: Looking ahead to 2025, how will the Ohio economy perform under SB 221? What if the SB 221 provisions were modified per Senate Bill 58?

  Projecting to 2025, we estimate that continuation of current SB 221 provisions will result in lower electricity demand, lower electricity prices, more jobs created, and less CO_2 emissions compared to the modifications proposed under SB 58. If SB 58 is enacted, the net effect of these differences is an **electricity bill 3.9% higher than projected under maintaining the current SB 221 Actual Scenario (AS)**. **This translates into increases of $1.1 billion between 2014 and 2020 and $3.65 billion between 2014 and 2025, with average annual increases of $300 million.** Further maintaining the current provisions in SB 221 will lead to increased investment within Ohio for renewable energy and energy efficiency projects, leading to higher employment and lower CO_2 emissions.

For purposes of this project, OSU utilized a state-of-the-art model called Dynamic Energy-Economic Policy Simulation (DEEPS).[3] DEEPS was developed by OSU for the State of Ohio, in collaboration with the Consortium for Energy, Economics and the Environment at Ohio University, with funding and guidance from the Ohio Department of Development, and in partnership with the the Public Utilities Commission of Ohio and the Ohio Environmental Protection Agency. Further information about the DEEPS model is available at www.OhioEnergyResources.com.

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[1] Advanced Energy Economy Ohio Institute (AEEO) seeks to foster a robust, advanced energy economy, drive technology innovation and implementation, and position Ohio as a global leader by enhancing and aligning existing business networks and assets. In particular, AEEO provides information to Ohio policy makers regarding potential pathways for a transition to a diverse, competitive Ohio economy that utilizes advanced energy technologies.

[2] The Center for Resilience is an interdisciplinary research center dedicated to improving the sustainability and resilience of industrial systems and the environments in which they operate. See www.resilience.osu.edu

[3] Using an integrated modeling approach called "system dynamics", coupled with data on historical trends, DEEPS is able to estimate the past and future economic, social, and environmental benefits associated with alternative energy policies. OSU retained the services of Dr. Andrea Bassi, an internationally-recognized expert in the field of energy policy modeling.

Additional details are provided below for the two scenarios analyzed.

Retrospective scenario analysis (2008-2012)

To perform a retrospective analysis of SB 221, two scenarios were defined:

- **Actual Scenario (AS):**

  Represents actual Ohio history with the following SB 221 provisions in place.

  - Renewable Portfolio Standard (RPS): 12.5% of power generation to come from renewable sources by 2025.
  - Energy Efficiency Portfolio Standard: 22.2% cumulative electricity efficiency savings by 2025; and 7% peak demand reduction by 2017 for electric utilities.

- **Retrospective "Fallback" Scenario (FS):**

  Assumes SB 221 was never implemented.

The DEEPS simulation indicates that, from 2008 to 2012, the following benefits were realized:

- Overall, the SB 221 RPS and EE standards have led to a 1.4% reduction in Ohio electricity bills by 2012.
- RPS and EE standards reduced electricity use by 2.6% and overall energy demand by 2% (1.55% and 1.21% in 2012 alone, respectively).
- Improvements in energy efficiency reduced electricity generation by 2.4%, while the RPS increased power generation from renewables by 63.8% (40.75% in 2012 alone).
- Greenhouse gas emissions (carbon dioxide) declined by 1.9% due to the simultaneous effect of demand and supply interventions, as well as macroeconomic impacts.

As a result of increased power generation from renewables, electricity generation costs are estimated to have increased by 0.12% in 2011 and 0.30% in 2012, with no change observed in previous years. Nevertheless, the model indicates that improvements in energy efficiency have more than offset this increase in power generation costs, leading to a 1.9% reduction in electricity costs by 2012. For 2012, the effect of energy efficiency alone is estimated to reduce the electricity costs by 1.16%, equivalent to $190 million. For 2008 to 2012, ratepayer savings are estimated to be $230 million.[4]

With regard to macroeconomic impacts, the model indicates a cumulative increase in public and private investment of 8.5% and 0.94% by 2012 respectively (4.2% and 0.5% in 2012). This corresponds to direct and indirect investment of about $600 million and $60 million respectively in 2012 alone. The increased investment is estimated to have yielded the following benefits.

- Stimulated GDP by 0.04%, or $160 million in 2012
- Generated savings on the energy bill of up to $190 million in 2012
- Created over 3,200 Ohio jobs in the period from 2008 to 2012.

In summary, this retrospective analysis indicates that synergies due to the combination of energy efficiency and renewable energy, as well as the associated cost savings and employment generation, are encouraging, especially considering that these investments will have primarily medium to longer-term positive impacts. These findings are supported by the subsequent prospective analysis described in the next section.

The results of the DEEPS retrospective simulation are summarized in the table and the graphs below.

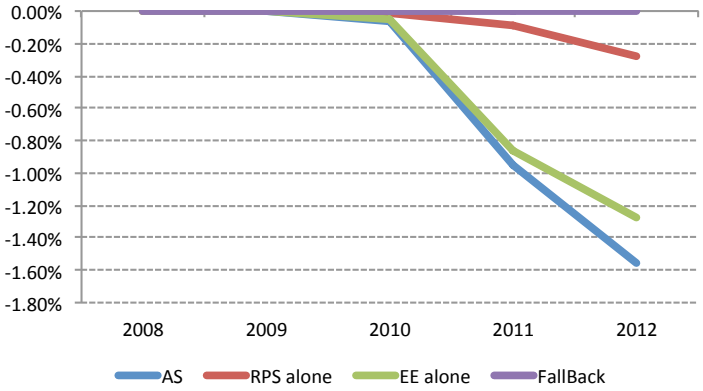
[4] Importantly, this study does not review the electricity bill savings associated with bidding energy efficiency resources into regional capacity markets; this is a practice that began in mid 2012 and is expected to produce considerable savings for customers in addition to the savings produced directly through energy efficiency programs and investments.

Summary of DEEPS Retrospective Results (selected indicators)

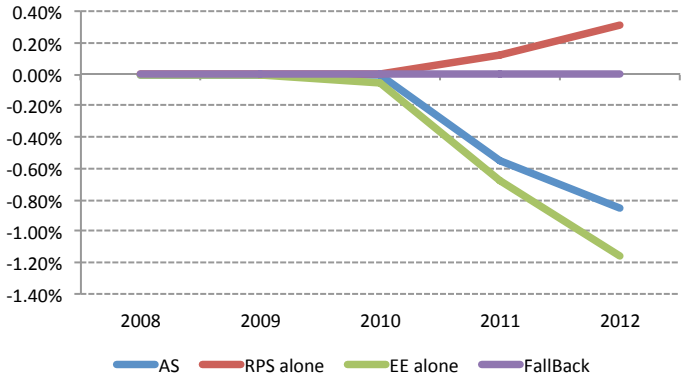
Cumulative (2008 to 2012) and annual (2012) percent change relative to the Fallback Scenario (no SB 221) for key selected energy and economic indicators, showing separate and combined impacts of Renewable Portfolio Standard (RPS) and Energy Efficiency (EE).

	% change 2012	% change 2008 - 2012		% change 2012	% change 2008 - 2012
Total Electricity Demand			**Electricity cost**		
AS (RPS + EE)	-1.55%	-2.57%	AS (RPS + EE)	-0.85%	-1.41%
RPS alone	-0.28%	-0.38%	RPS alone	0.30%	0.43%
EE alone	-1.27%	-2.20%	EE alone	-1.16%	-1.90%
Total renewable electricity generation			**Total power sector employment**		
AS (RPS + EE)	40.75%	63.76%	AS (RPS + EE)	3.93%	16.77%
RPS alone	41.22%	64.36%	RPS alone	4.07%	17.04%
EE alone	0.00%	0.00%	EE alone	0.00%	0.00%
Total CO_2 emissions			**Government investment**		
AS (RPS + EE)	-1.18%	-1.92%	AS (RPS + EE)	4.18%	8.46%
RPS alone	-0.35%	-0.50%	RPS alone	1.60%	3.34%
EE alone	-0.83%	-1.42%	EE alone	2.58%	5.12%

Annual percent change relative to the Fallback Scenario for **total electricity demand**, showing separate and combined effects of Renewable Portfolio Standard (RPS) and Energy Efficiency (EE).



Annual percent change relative to the Fallback Scenario for **total electricity cost**, showing separate and combined effects of Renewable Portfolio Standard (RPS) and Energy Efficiency (EE).



Prospective scenario analysis (2013 - 2025)

To perform a prospective analysis of SB 221, two scenarios were defined:

- **Actual Scenario (AS):**

  Assumes continuation of current policies, with the following SB 221 provisions in place.
  - Renewable Portfolio Standard (RPS): 12.5% of power generation to come from renewable sources by 2025. (This includes a 50% REC requirement, with expansion of wind, hydro, and solar power).
  - Energy Efficiency Portfolio Standard: 22.2% cumulative electricity efficiency savings by 2025; and 7% peak demand reduction by 2017 for electric utilities.

- **Prospective "Modified" Scenario** (SB 58):

  Assumes modification of SB 221 as proposed in the new Senate Bill 58 (SB 58). The following potential modifications were analyzed:
  - Renewable Portfolio Standard (RPS): includes only projects already operational, matching the AS until 2013 and allowing the share of renewables to reach only 1.24% of power generation by 2025.
  - Energy Efficiency (EE) Portfolio Standard: excludes mercantile customers above 700,000 kWh per year in the commercial and industrial sectors. We estimate that this will effectively reduce the statewide EE-based energy savings by about 40%.
  - Expenditures on energy efficiency by utilities capped at 2013 levels ($233 million/yr), assuming a cost of 2c/kWh.

The DEEPS projection indicates that, under the AS, continuation of current SB 221 provisions will have the following estimated benefits in comparison to the proposed SB 58.

- Lower electricity demand (-2.9% by 2025), primarily due to improved energy efficiency
- Lower electricity prices (-0.6% in 2025), due to the cost suppression achieved through the introduction of renewables, such as wind power
- Creation of more jobs, over 3,000 by 2025 due to the higher labor intensity of renewables relative to thermal power generation
- Reduced greenhouse gas emissions (-7.5% in 2025), due to the lower carbon intensity of the new energy mix of power generation, as well as lower energy consumption.

If SB 58 is enacted, the net effect of these differences is an **electricity bill 3.9% higher than projected under maintaining the current SB 221 AS**. **This translates into increases of $1.1 billion between 2014 and 2020 and $3.65 billion between 2014 and 2025, with average annual increases of $300 million.** Further maintaining the current provisions in SB 221 will lead to increased investment within Ohio for renewable energy and energy efficiency projects, leading to higher employment and lower CO_2 emissions.

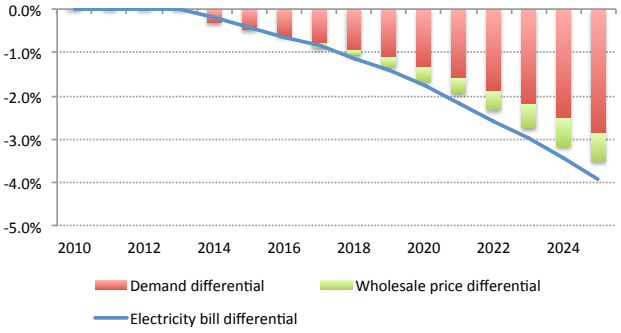
With regard to energy efficiency, we estimate that the additional investment required for the AS relative to the SB 58 case, based on a levelized annual average, could range between $48 million and $120 million per year (assuming a cost range between 2 cents and 5 cents per kWh). At the high end of this range, the investment would drive a 1.5% increase in electricity price per kWh by 2025. However, this price increase is offset by cost suppression due to renewable sources (-0.6%) and overall efficiency-based savings of over $300 million per year.

If utility expenditures on energy efficiency are capped, as proposed under SB 58, then the additional investment required to meet the SB 221 EE target by 2025 would be possible only under the 2c/kWh scenario. However, if the costs exceed 2c/kWh, then the original SB 221 target could not be met.

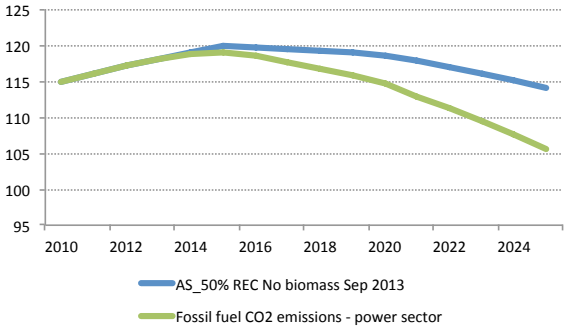
As discussed in the section below (p. 6), this analysis is consistent with sectoral studies carried out by other organizations (i.e., PUCO on cost suppression, WRI on emission reduction, and ACEEE on energy efficiency savings) and confirms the results of our previous retrospective study. In summary, it indicates that the synergies created by the combination of energy efficiency and renewable energy, as well as the associated cost savings and employment generation, are having positive impacts on Ohio's economy and will continue to be beneficial in the medium to longer term.

Highlights of DEEPS Prospective Results (selected indicators)

Projected cumulative reductions in **electricity bill** under SB 221 (AS with no biomass) compared to SB 58, due to reduced demand and reduced wholesale prices



Projected annual **carbon dioxide emissions** (million tons per year) under SB 221 (AS with no biomass) compared to SB 58



	Units	2013	2015	2020	2025
Total Electricity Demand					
SB 58	GWh/year	169,233	171,223	173,953	173,129
AS (no biomass)	GWh/year	169,233	170,426	171,628	168,187
Demand differential	*%*	*0.0%*	*-0.5%*	*-1.3%*	*-2.9%*
Total electricity generation from renewables					
SB 58	GWh/year	2,075	2,353	2,353	2,353
AS (no biomass)	GWh/year	2,075	2,658	5,695	9,614
Electricity generation differential	*%*	*0.0%*	*13.0%*	*142.0%*	*308.6%*
Electricity price per kWh					
SB 58	USD/kWh	0.0922	0.0926	0.0933	0.0929
AS (no biomass)	USD/kWh	0.0922	0.0926	0.093	0.0923
Wholesale price differential	*%*	*0.0%*	*0.0%*	*-0.3%*	*-0.6%*
Electricity bill					
SB 58	Billion USD/year	16.31	16.58	16.97	16.83
AS (no biomass)	Billion USD/year	16.31	16.51	16.67	16.17
Electricity bill differential	*%*	*0%*	*-0.9%*	*-1.8%*	*-3.9%*
Avoided energy cost	*Billion USD/year*	*0*	*-0.07*	*-0.3*	*-0.66*
Fossil fuel CO_2 emissions - power sector					
SB 58	Million Ton/year	118.12	119.95	118.70	114.12
AS (no biomass)	Million Ton/year	118.12	119.15	114.64	105.59
Emissions differential	*%*	*0.0%*	*-0.7%*	*-3.4%*	*-7.5%*
Total power sector employment					
SB 58	People	16,417	13,992	12,586	11,258
AS (no biomass)	People	16,417	16,259	16,445	14,286
Employment differential	*%*	*0.0%*	*16.2%*	*30.7%*	*26.9%*

Comparison with Similar Studies

For purposes of validation, the DEEPS analysis was compared against several recent studies of the Ohio energy economy, each with slightly different assumptions:

Public Utilities Commission of Ohio (PUCO)

PUCO conducted an analysis of anticipated price suppression due to adoption of renewable energy.[5] For this analysis, PUCO assumed that the lowest-cost renewable technologies would dominate, and therefore included only operational, pending and approved wind projects. In contrast, the original baseline scenario (AS) of DEEPS included solar, wind, hydro and biomass. To compare the results of the DEEPS simulation with the PUCO analysis, we removed solar and biomass and considered only wind and hydro. These two energy sources (wind and hydro) have similar costs, and are dispatched generally before fossil fuels.

In this case the DEEPS results indicated lower electricity prices due to the removal of the more expensive biomass (waste to energy) technology. The reduction in electricity prices by 2025 reaches 1.5% (for 2,703 MW), which should be compared to an extrapolation of the PUCO results, indicating a potential price reduction up to 1.96%. For reference, the reduction calculated by PUCO for 2014, considering existing and operational projects, is 0.15% (for 450 MW). This reduction increases to 0.67% when considering also the ones approved but not yet operational (for a total of 1,302 MW).

World Resources Institute (WRI)

WRI conducted a modeling study of the opportunities for reducing carbon dioxide emissions in Ohio. The study projects a 7% emission reduction by 2020 relative to 2011, and roughly (based on their graph) a 19% reduction by 2025 relative to 2010.[6] The results of this study are well aligned with the DEEPS results under the original AS scenario. However, with the adjusted AS scenario (no biomass), since electricity prices are lower, power demand is projected to be higher, and emissions decline only 13% by 2025. The WRI results may reflect an expectation of increasing wholesale prices in future years to come, but details are not provided in the report.

American Council for an Energy-Efficient Economy (ACEEE)

ACEEE analyzed the expected economic impacts of the energy efficiency standard in Ohio.[7] Their study projects a total $5.57 billion savings through 2020, $3.3 billion of which represent wholesale cost savings. The DEEPS analysis with the adjusted AS scenario estimates that wholesale cost savings will reach $1.75 billion between 2010 and 2020 and $4.4 billion by 2025.

Conclusions

The DEEPS model is able to generate results that are consistent with the more detailed and thematic studies available (e.g., energy supply vs. cost savings). It appears that the future energy mix will likely have noticeable impacts on electricity generation cost (and as a consequence on wholesale prices) as well as power demand. Therefore, the assumptions used in the various studies available should be carefully analyzed before a comparative assessment of their results is carried out. On the other hand, despite differences in baseline projections (i.e., absolute results), it is worth noting that the relative policy-induced impacts do not change considerably (e.g., percentage emission reductions).

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[5] The Public Utilities Commission of Ohio (2013). *Renewable Resources and Wholesale Price Suppression*. The Public Utilities Commission of Ohio (PUCO). Columbus, Ohio, USA.

[6] Obeiter, M., K. MeeK, and R. Gasper (2013). *Power Sector Opportunities for Reducing Carbon Dioxide Emissions: Ohio*. World Resources Institute. Washington DC, USA.

[7] Neubauer, M., B. Foster, R. N. Elliott, D. White, and R. Hornby (2013). *Ohio's Energy Efficiency Resource Standard: Impacts on the Ohio Wholesale Electricity Market and Benefits to the State*. American Council for an Energy-Efficient Economy. Washington DC, USA.