

# **Economic Impacts of the Millstone Power Station**

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**An Analysis by the Nuclear Energy Institute**

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## Executive Summary

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**Millstone's operation and support of low prices support 4,800 jobs in Connecticut.**

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The Millstone Power Station (Millstone), located near New London, Connecticut, has long been a vital part of the region's energy portfolio, providing 100 percent carbon-free electricity since Millstone Unit 1 began operating in 1970. In addition to the reliable, emission-free electricity that the plant generates and the jobs and economic stimulus it provides, the plant's involvement in its community also makes Millstone a significant economic contributor to the state of Connecticut and the northeastern United States.

To quantify the economic impacts of this facility, the Nuclear Energy Institute (NEI) conducted an independent analysis. Based on data provided by Dominion (Millstone's operator) on employment, operating expenditures and tax payments, NEI conducted the analysis using the PI+ model provided by Regional Economic Models, Inc. (REMI), which is a nationally recognized model. (See section 4 of this report for more information.)

### Key Findings

Millstone's operations provide:

**Economic stimulus from operations and lower electricity prices.** Millstone produces significant economic benefits for Connecticut and the rest of New England, both through its operations and through the lower electricity prices it supports. NEI's analysis finds that Millstone generates \$2.6 billion in annual economic output for all of New England. This includes almost \$1.3 billion for Connecticut and more than \$1.3 billion for the other states in New England (Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont).

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**Across New England, Millstone provides \$2.6 billion economic benefits. Approximately \$1.3 billion of these benefits occur in Connecticut.**

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**Economic benefits for Connecticut.** The annual additional economic output Millstone generates for Connecticut includes:

- \$873 million from station operations
- \$402 million from lower electricity prices
- A total of nearly \$1.28 billion in total economic benefits.

**Economic benefits for the rest of New England.** The annual additional economic output Millstone generates for other New England states includes:

- \$81 million from station operations
- \$1.25 billion from lower electricity prices
- A total of over \$1.33 billion in total economic benefits.

**Long-term economic stimulus.** Additionally, this study finds that between 2016 and 2030, Millstone's operations will generate over \$12 billion in economic output in Connecticut and \$1.3 billion in the rest of New England (not including benefits from lower electricity prices). Further the station's operation con-

tributes \$630 million to Connecticut's gross state product each year.

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**Millstone's operation results in over \$13 billion in economic benefits over the next 15 years from operations. Millstone also keeps electricity prices lower, which adds billions more in economic benefits.**

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**Employment benefits from operations and lower electricity prices.** Millstone supports thousands of jobs in Connecticut and the rest of New England, both through its operations and through lower electricity prices. NEI estimates that the total number of jobs supported by Millstone annually in New England, including Connecticut, is over 12,100 jobs. That includes almost 4,800 jobs in Connecticut and more than 7,300 in the rest of New England.

**Employment benefits for Connecticut.** The annual employment benefits from Millstone for Connecticut include:

- 2,737 jobs from station operations
- 2,062 jobs from lower electricity prices
- A total of 4,799 jobs.

**Employment benefits for the rest of New England.** The annual employment benefits from Millstone for other New England states include:

- 523 jobs from station operations
- 6,784 jobs from lower electricity prices
- A total of 7,307 jobs.

**Clean electricity for Connecticut and New England.** Emission-free electricity from Millstone prevents the release of 8.3 million metric tons of carbon dioxide annually, about the same amount of carbon dioxide released by approximately 1.9 million cars every year. For perspective, there are an estimated 1.4 million passenger cars in Connecticut. These avoided emissions have economic value. Between 2016 and 2030, Millstone will have provided over \$6 billion in benefits from avoided emissions.

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**Millstone prevents emissions of 8.3 million metric tons of carbon dioxide annually, approximately the same amount of carbon dioxide released by approximately 1.9 million cars each year.**

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**Reliability benefits.** During full-power operation, Millstone provides 2,111 megawatts of around-the-clock electricity to Connecticut homes and businesses. In 2015, the station operated at 96 percent of capacity, which is above the industry average and significantly higher than other forms of electric generation. This reliable production helps offset potential price volatility of other energy sources (e.g., natural gas) and the intermittency of renewable electricity sources.

**Low-cost electricity to consumers.** Based on NEI's analysis of a July 2015 Brattle Group report on nuclear power benefits, Millstone's operation keeps wholesale electricity prices 12 percent lower in New England than they would be if the plant closed. Millstone is the largest generator of electricity in Connecticut and New England. Millstone generates enough power to satisfy 58.9 percent of Connecticut's electricity demand, or 14.4 percent of New England's electricity demand.

**Tax impacts.** Operating Millstone is estimated to contribute approximately \$40 million in local and state taxes.

## Section 1

# Background and Generation History



### Millstone Power Station

#### *First dates of commercial operation*

Millstone 2 - 1975

Millstone 3 - 1986

#### *Location*

In Waterford, Conn., 40 miles  
Southeast of Hartford, Conn.

#### *License Expiration Years*

Millstone 2 - 2035

Millstone 3 - 2045

#### *Reactor Types*

Pressurized water

#### *Total Electrical Capacity (Megawatts)*

Millstone 2 - 884

Millstone 3 - 1,227

The Millstone Power Station (Millstone) is located on a 535-acre site near New London, Connecticut. It consists of two operating Pressurized Water Reactors (PWRs) that produce 2,111 MW of non-emitting base-load power. This site is also home to Millstone Unit 1, a Boiling Water Reactor (BWR) that ceased operations in 1998. The operator of Millstone, Dominion, owns 100 percent of Millstone Unit 2 and 93.47 percent of Millstone Unit 3. Massachusetts Municipal Wholesale Electric Company owns 4.8 percent and Green Mountain Power Corporation owns 1.73 percent of Millstone Unit 3.

### Reliable Electricity Generation

Millstone 2 and 3 operated at a capacity factor of approximately 96 percent in 2015, above the industry average. Capacity factor, a measure of electricity production efficiency, is the ratio of actual electricity generated to the maximum possible electric generation during the year.

### Thousands of Local Jobs

Millstone employs 1,569 full-time workers, and supports an additional 1,691 jobs in Connecticut and New England from operations.<sup>1</sup> The annual payroll and benefits are approximately \$180 million, and millions more for contract labor. Most jobs at nuclear power plants require technical training and are typically among the highest-paying jobs in the area. Nationwide, nuclear energy jobs pay 36 percent more than average salaries in a plant's local area.<sup>2</sup>

Lower electricity prices also stimulate job creation in Connecticut and New England by enabling consumers and businesses to spend less on electricity and more in other parts of the economy. These lower prices stimulate a further 8,850 jobs in Connecticut and New England.

### Safe and Clean for the Environment

Nuclear energy facilities generate large amounts of electricity without emitting greenhouse gases. State and federal policymakers recognize nuclear energy as an essential source of safe, reliable electricity that meets both environmental needs and demand for electricity.

<sup>1</sup> For the purposes of this report, "New England" or the "Rest of New England" consists of Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont.

<sup>2</sup> Nuclear Energy's Economic Benefits—Current and Future. Nuclear Energy Institute, April 2014.

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**By producing carbon-free electricity, Millstone provides \$6.2 billion in benefits from reduced carbon emissions.**

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Millstone, like all nuclear power plants, produces baseload power that is carbon-free. As the largest generation station in New England at 2,111 megawatts of capacity, Millstone produced 17.4 million megawatt hours of electricity that avoided the emission of over 8.34 million metric tons of CO<sub>2</sub> in 2015.<sup>3</sup> Overall, Connecticut's electric sector emits approximately 7 million metric tons of carbon dioxide annually. According to ISO-New England, New England's power sector (including Connecticut) emitted approximately 30 million metric tons of CO<sub>2</sub> in 2015.<sup>4</sup>

Recently, New York State established a Clean Energy Standard that places a value on carbon-free electricity based on the Social Cost of Carbon values. In August 2016, the U.S. Court of Appeals for the Seventh Circuit validated the Social Cost of Carbon as a legitimate method for placing a value on the benefits of carbon reduction.<sup>5</sup> Between 2016 and 2030, assuming Millstone avoids 8.34 million metric tons a year, these avoided emissions would represent an avoided cost of \$6.2 billion in cumulative benefits.<sup>6</sup>

Millstone also prevents the release of other air pollutants such as nitrogen oxide and sulfur dioxide, which are precursors to acid rain and urban smog. These compounds are limited by federal regulations. In 2015, the plant avoided the emission of 2,500 tons of nitrogen oxide and 2,400 tons of sulfur dioxide.

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<sup>3</sup> Emissions prevented are calculated using regional fossil fuel emission rates from the U.S. Environmental Protection Agency and plant generation data from the U.S. Energy Information Administration.

<sup>4</sup> Patricia Silva, ISO-NE Senior Analyst of System Planning, "Environmental Update to the Planning Advisory Committee." ISO-New England, February 17, 2016.

<sup>5</sup> *Zero Zone, Inc., et al., v. U.S. Department of Energy*

<sup>6</sup> The Social Cost of Carbon values are from the Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12866, *Interagency Working Group on Social Cost of Carbon, United States Government, July 2, 2015. The values are in 2007 dollars and were inflated using the GDP deflator to 2015 dollars. The calculation is based on the carbon intensity of generation in ISO-New England.*

## Section 2

# Economic and Employment Benefits for State and Regional Economies from Millstone Operations



*Millstone Power Station*

NEI used the REMI PI+ model to analyze economic and expenditure data provided by Dominion to develop estimates of its economic benefits from Millstone Power Station's (Millstone) operations. More information on REMI can be found in Section 4.

The economic impacts of Millstone discussed in this section consist of the following variables that are used to analyze these impacts:

### **Output**

Output is a value of economic activity. The direct output is the economic activity produced by Millstone. The secondary output is the value of the economic activity generated in other industries because of Millstone as well as how people employed at the facility influence the demand for goods and services within the region.

### **Employment**

The direct employment is the number of jobs at Millstone. Secondary employment is jobs in other industries as a result of Millstone's operations.

### **Gross State Product**

Millstone contributes to Connecticut's Gross State Product, which is the value of goods and services produced by labor and property—sales (output) minus intermediate goods. In the REMI model, electricity is the final good from a nuclear plant. Intermediate goods are the components purchased to make that electricity.

## **State and Regional Economic Effects**

Millstone's total economic output impact on Connecticut is estimated to be \$870 million. In other words, for every dollar of output from Millstone, the state produced \$1.20. Including economic impact on the rest of New England, Millstone provides nearly \$954 million in direct and secondary economic impact. Millstone also contributes about \$637 million to Connecticut's gross state product each year.



Walkway constructed by Millstone volunteers.

Table 2.1 summarizes the plant’s effects on Connecticut and New England economies and GSP in 2017 from operations. Millstone’s operations have a substantial economic impact on other industries in Connecticut and elsewhere in New England.

Millstone’s output also stimulates the state’s and region’s labor income and employment. The plant employs 1,060 people in permanent jobs and 509 contractors.<sup>7</sup> These jobs stimulate nearly 1,700 additional jobs in Connecticut and New England. Table 2.2 details the quantity and types of jobs that Millstone supports. Plant workers are included in the occupation categories in the table.

Millstone’s operation resulted in an estimated total tax impact of approximately \$40 million to local and state governments.<sup>8</sup> This is the direct impact that supports the funding of local schools, police, fire departments, and other important public services. There also are secondary impacts, because Millstone’s expenditures increase economic activity, leading to additional income and value creation and, therefore, to higher tax revenue.

**Table 2.1**  
**Millstone’s Impact on the Connecticut and New England Economies in 2017**  
*(dollars in 2015 millions)*<sup>9</sup>

Description	Direct	Secondary	Total
<i>Connecticut</i>			
Output	\$729	\$144	\$873
Gross State Product			\$637
<i>Rest of New England</i>			
Output		\$81	\$81
Gross Domestic Product			\$51

<sup>7</sup> The 509 contractors are based on a three-year average of hours billed by contract labor to calculate an average full-time equivalent number.

<sup>8</sup> Calculated based on a percentage of gross state product.

<sup>9</sup> Total output and gross domestic product for the Rest of New England are based on the direct operations of Millstone.

**Table 2.2**  
**Job Impacts from Millstone Operations**

Category	Connecticut	Rest of N.E.	Total
Utilities	1,569	0	1,569
Retail Trade	260	46	306
Health Care and Social Assistance	216	54	270
Other Services, except Public Administration	187	82	269
Professional, Scientific, and Technical Services	106	114	220
Accommodation and Food Services	97	32	129
Administrative and Waste Management Services	48	28	76
Finance and Insurance	51	24	75
Real Estate and Rental and Leasing	46	14	60
Educational Services	30	22	52
Manufacturing	17	34	51
Other Industries	110	73	183
<b>Total</b>	<b>2,737</b>	<b>523</b>	<b>3,260</b>

## Section 3

# Economic and Employment Benefits for State and Region from Lower Electricity Prices



*Millstone employees volunteering in the community.*

This report also analyzes the economic benefits of lower electricity prices from the operation of Millstone Power Station (Millstone). Again, NEI used the REMI PI+ model for the analysis. The inputs were estimated using price increase information from a Brattle Group report of July 2015 on nuclear power benefits. The Brattle Group found that prices in New England would increase 24 percent without nuclear power.<sup>10</sup> Millstone forms 52 percent of New England's nuclear capacity. This analysis assumes that the cost increases are linear, and wholesale prices would therefore increase by 12 percent, or \$6.83/MWh, without Millstone. Across Connecticut and New England, residential consumers would see their costs increase by \$323 million and commercial and industrial consumers would see costs increase by \$490 million without Millstone.

The economic impacts of lower electricity prices from Millstone operations discussed in this section consist of the following main variables:

**Output:** The output discussed in this section is the economic activity created by lower electricity prices in Connecticut and New England. High electricity prices create a potentially adverse impact on businesses and industry that could lead to lost economic activity. Households would also have less discretionary income to spend on goods and services if their electricity bills increased.

**Employment:** Lower electricity prices support jobs in Connecticut and New England. Higher costs to business operations could force companies to reduce the numbers of employees or move out of the region.

### State and Regional Benefits of Low-Cost Electricity

A detailed depiction of Millstone's impact on a variety of economic sectors is in Table 3.1. In Connecticut, finance and insurance, manufacturing, and utilities benefit most. Other industries receiving substantial benefits are real estate, health care and retail trade. In New England, low-cost electricity stimulates substantial activity in manufacturing, finance and insurance, and real estate. Many other sectors benefit as well, such as utilities, health care and retail trade.

Table 3.2 depicts additional jobs by sector that are supported because of the lower electricity prices because of Millstone's operations. Millstone supports 2,062 jobs in Connecticut and a further 6,784 jobs in the rest of New England. Although not modeled in this analysis, low electricity prices increase economic activity, leading to additional income and value creation and, therefore, to higher tax revenue for communities supporting local services such as police, fire fighting and education.

<sup>10</sup> *The Nuclear Industry's Contribution to the U.S. Economy. The Brattle Group, July 2015.*

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**By keeping electricity prices lower, Millstone supports substantial economic activity and jobs. Nearly \$1.7 billion in economic activity and over 8,800 jobs are supported annually due to lower electricity prices.**

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**Table 3.1**  
**Millstone's Estimated Total Impact in 2017 from Lower Electricity Prices**  
*(output in millions of 2015 dollars)*

Occupation	Connecticut	Rest of N.E.	Total
Manufacturing	\$57	\$220	\$277
Finance and Insurance	\$67	\$151	\$218
Real Estate and Rental and Leasing	\$39	\$141	\$180
Utilities	\$49	\$118	\$167
Health Care and Social Assistance	\$31	\$102	\$133
Retail Trade	\$30	\$93	\$123
Information	\$20	\$78	\$98
Professional, Scientific, and Technical Services	\$20	\$71	\$91
All Other Industries	\$89	\$279	\$368
<b>Total</b>	<b>\$402</b>	<b>\$1,253</b>	<b>\$1,655</b>

**Table 3.2**  
**Job Impacts from Lower Electricity Prices**

Category	Connecticut	Rest of N.E.	Total
Retail Trade	331	1,078	1,409
Health Care and Social Assistance	323	1,038	1,361
Other Services, except Public Administration	217	676	893
Accommodation and Food Services	185	679	864
Finance and Insurance	213	490	703
Manufacturing	108	466	574
Professional, Scientific, and Technical Services	116	384	500
Administrative and Waste Management Services	109	356	465
Real Estate and Rental and Leasing	87	299	386
Arts, Entertainment, and Recreation	63	229	292
Wholesale Trade	60	210	270
All Other Industries	250	879	1,129
<b>Total</b>	<b>2,062</b>	<b>6,784</b>	<b>8,846</b>

## Section 4

### **Economic Impact Analysis Methodology**

This analysis uses the REMI PI+ model to estimate the economic and fiscal impacts of the Millstone Power Station.

#### **Regional Economic Models, Inc. (REMI)**

REMI is a modeling firm specializing in services related to economic impacts and policy analysis, headquartered in Amherst, Mass. It provides software, support services, and issue-based expertise and consulting in almost every state, the District of Columbia, and other countries in North America, Europe, Latin America, the Middle East and Asia.

The REMI model has two main purposes: forecasting and analysis of alternatives. All models have a “baseline” forecast of the future of a regional economy at the county level. Using “policy variables,” in REMI terminology, provides scenarios based on different situations. The ability to model policy variables makes it a powerful tool for conveying the economic “story” behind policy. The model translates various considerations into understandable concepts like GDP and jobs.

REMI relies on data from public sources, including the Bureau of Economic Analysis, Bureau of Labor Statistics, Energy Information Administration and the Census Bureau. Forecasts for future macroeconomic conditions in REMI come from a combination of resources, including the Research Seminar in Quantitative Economics at the University of Michigan and the Bureau of Labor Statistics. These sources serve as the main framework for the software model needed to perform simulations.

#### **Policy Insight Plus (PI+)**

REMI’s PI+ is a computerized, multiregional, dynamic model of the states or other sub-national units of the United States economy. PI+ relies on four quantitative methodologies to guide its approach to economic modeling:

1. Input/output tabulation (IO)—IO models, sometimes called “social accounting matrices” (SAM), quantify the interrelation of industries and households in a computational sense. It models the flow of goods between firms in supply-chains, wages paid to households, and final consumption by households, government and the international market. These channels create the “multiplier” effect of \$1 going further than when accounting for its echoing.

2. Computable general equilibrium (CGE)—CGE modeling adds market concepts to the IO structure. This includes how those structures evolve over time and how they respond to alternative policies. CGE incorporates concepts on markets for labor, housing, consumer goods, imports and the importance of competitiveness to fostering economic growth over time. Changing one of these will influence the others—for instance, a new knife factory would improve the labor market and then bring it to a head by increasing migration into the area, driving housing and rent prices higher, and inducing the market to create a new subdivision to return to “market clearing” conditions.
3. Econometrics—REMI uses statistical parameters and historical data to populate the numbers inside the IO and CGE portions. The estimation of the different parameters, elasticity terms and figures gives the strength of various responses. It also gives the “time-lags” from the beginning of a policy to the point where markets have had a chance to clear.
4. New economic geography—Economic geography provides REMI a sense of economies of scale and agglomeration. This is the quantification of the strength of clusters in an area and their influence on productivity. One example would include the technology and research industries in Seattle. The labor in the area specializes to serve firms like Amazon and Microsoft and, thus, their long-term productivity grows more quickly than that of smaller regions with no proclivity towards software development (such as Helena, Mont.). The same is true on the manufacturing side with physical inputs, such as with the supply-chain for Boeing and Paccar in Washington in the production of transportation equipment. Final assembly will have a close relationship and a high degree of proximity to its suppliers of parts, repairs, transportation and other professional services, which show up in clusters in the state.

## Conclusion

### Total Economic and Employment Impacts

NEI's analysis finds that Millstone generates more than \$2.6 billion in annual economic output for New England through its operations and through lower regional electricity prices. This includes almost \$1.3 billion for Connecticut and more than \$1.3 billion for the other states in New England (including Maine, Massachusetts, New Hampshire, Rhode Island, and Vermont) from both operations and lower electricity prices.

Additionally, NEI's analysis finds that Millstone supports more than 12,100 jobs annually in New England through its operations and through lower electricity prices. This includes almost 4,800 jobs in Connecticut and more than 7,300 elsewhere in New England from both operations and lower electricity prices.

### Economic Impacts from Operations and Lower Prices

Specifically, the estimated annual economic impacts (direct and secondary) for all of New England from Millstone's operations exceed \$950 million annually. This includes more than \$870 million in Connecticut and more than \$80 million in the other New England states. Millstone's operations also contribute \$630 million annually to Connecticut's gross state product.

The lower energy prices supported by the station also produce significant benefits for New England totaling more than \$1.65 billion in additional economic activity annually. This includes more than \$400 million in Connecticut and approximately \$1.25 billion in other New England states.

Additionally, the operation of the Millstone plant and its secondary effects account for almost 3,300 jobs annually throughout Connecticut and the rest of New England, including more than 2,700 jobs in Connecticut and more than 500 in the other states in New England.

The lower energy prices supported by Millstone also act to create jobs. NEI's analysis finds that these lower prices support more than 8,800 jobs annually throughout New England, including more than 2,000 in Connecticut and almost 6,800 in the rest of the region.

### Further benefits of Millstone

The station's economic benefits—on taxes and through wages and purchases of supplies and services—are considerable. In addition, plant employees further stimulate the local economy by purchasing goods and services from businesses around the area, supporting many small businesses in Connecticut and elsewhere in New England.

The facility generated 17.4 billion kilowatt-hours of emission-free electricity in 2015, enough to serve the yearly needs for almost two million homes, all while producing carbon-free power. This carbon-free electricity is estimated to provide over \$6 billion in health benefits over the next 15 years.

The Millstone Power Station is a leader economically, fiscally, environmentally and socially within Connecticut and has far-reaching economic impacts across the Northeast.

