POWER SUPPLY PERFORMANCE INDEX: ANNUAL STATE REPORT

ENERGY EFFICIENCY AND ENVIRONMENTAL PERFORMANCE

The purpose of this report is to provide electricity customers and stakeholders with improved methods for assessing the performance of electric power supply. The report provides a rating for each of the U.S. states in terms of its overall energy efficiency and environmental electricity supply performance. It also includes ratings for selected power suppliers and electricity procurement contracts.

In the same way that nutrition labels are designed to allow customers to make quick decisions about the food they eat and how it meets their nutritional needs, the Power Supply Performance Index (PSPI) will help consumers understand the environmental impact of the power they buy and how it compares with other options.

Many state governments are starting to require electricity or power content labels. This report reveals that consumers can gain access to key electricity performance data and provides the PSPI to make it easier for consumers to compare electricity supply performance in terms of performance metrics directly related to environmental impact.

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About Performance Excellence in Electricity Renewal (PEER™)
Former Motorola CEO Bob Galvin, sparked by the 2003 blackout in New York City, started the Galvin Electricity Initiative over concerns for the reliability of the nation's power system. He teamed with Kurt Yeager, former President and CEO of Electric Power Research Institute (EPRI), who then chaired an organization called the Perfect Power Institute. Together, they performed research and development with the assistance of the Underwriters Laboratories and a panel of industry experts. Built on a decade of research and development collaboration, PEER was born. After years of refinement, PEER was acquired by Green Business Certification Institute (GBCI®) in 2014, based on common reliability and sustainability aspects to the rating system. GBCI is the only certification and credentialing body within the green business and sustainability industry. For more information, visit gbci.org.

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1. Introduction

This report introduces the PEER^{tm} Power Supply Performance Index (PSPI) and uses the index to rate power generation energy efficiency and environmental performance for each of the 50 U.S. states   This is the first issuance of the state PSPI which will be issued each year to track performance trends and provide benchmarking data for use in evaluating alternative power supply options.

Power users, policy makers, and power suppliers can apply the PSPI to make more informed evaluations of performance for alternate power mixes. In addition, by using the PSPI to evaluate and specify performance of electricity supply organizations, customers can make more informed choices about their energy supply.

GBCI offers a new electricity performance rating system called PEER, which enables power users, microgrids, and power suppliers to rate and certify the sustainability of electricity systems. The PSPI uses performance metrics from the Energy Efficiency and Environment category of the PEER rating system. The performance transparency offered by PEER and the PSPI, in particular, will make it easier for customers to differentiate among the wide array of power mixes being offered by power suppliers, just as the Energy Star label helps consumers differentiate between products using electricity.

2. Energy Efficiency and Environment Performance Assessment

2.1 The Case for the PEER Power Supply Performance Index

Electricity customers and stakeholders are concerned with the environmental impacts and energy inefficiencies associated with their electricity use. In fact, electric power generation wastes more than 60% of the input energy, is a major contributor to ozone formation and hazardous emissions, and is responsible for about 40 percent of man-made carbon dioxide emissions.[1] In the past, the measure of performance was focused largely on increasing renewable generation. While renewable generation is crucial to sustainability, it alone does not give a complete picture of the environmental impact of power generation performance.

Shifting the focus to key performance outcomes can lead to more informed choices and dramatically improved performance through procurement, design, and policy choices. Comprehensive metrics are the first step in a strategic process that leads to smarter, more directed improvements:

1. Measure current performance
2. Calculate waste and its inherent costs
3. Compare performance to industry standards
4. Identify key areas that could improve performance
5. Calculate value of proposed improvements

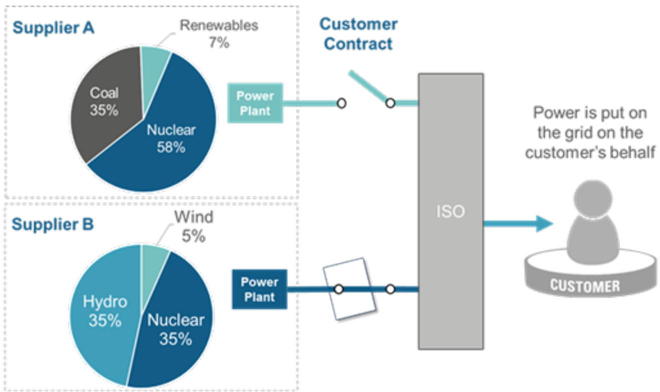
At the end of this process, a business case can be made for the necessity of improvements or choosing a more efficient and cleaner supply.

[1] U.S. Department of Energy and U.S. Environmental Protection Agency (2000). *Carbon Dioxide Emissions from the Generation of Electric Power in the United States*. Retrieved from: www.eia.doe.gov/electricity/page/co2_report/co2report.html.

2.2 Power Supply Contracts

In today's power markets, electricity generators and electricity suppliers must have a contract with a customer, utility, or system operator to put power into the grid (see Figure 1). As a result, customers can and have asked power suppliers to disclose performance data for the power put into the grid by their supplier per the customer contract.

Figure 1: Customer Contracts Disclosing Performance Data



For many customers, the local utility has the authority to handle this contract and provide power to the grid on their behalf. In restructured markets, however, customers have the opportunity to contract with suppliers that ostensibly put cleaner generation into the grid. In the current environment, making this decision can be difficult and arbitrary as there is no standard data available for customers to evaluate their options.

Many states now require greater transparency regarding the content of the power supplied to the grid on their behalf.[2] The requirements vary dramatically between states with some states only requiring that the power mix be provided while other states require that overall environmental performance for the power be reported. For example, the Massachusetts Power Information Disclosure Label[3] requires suppliers to describe the sources of electricity that are put into the power grid and to provide overall air emissions performance metrics for the energy mix. Power content labeling is required in most restructured states for investor owned competitive suppliers. However, these requirements often do not apply to municipal utilities and electrical co-operatives in restructured states. Consequently, the opportunity exists to improve transparency in restructured states, as well.

While significant attention has been placed on energy efficiency in buildings, there is little emphasis on assessing or improving the energy efficiency of the power supplied to these buildings. As power choices for residents and businesses proliferate, consumers must realize that making smart energy source choices can have more of an impact than high-efficiency light bulbs and UV-blocking windowpanes. The PSPI provides customers with a system for evaluating power energy efficiency and environmental impact.

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[2] *An Analysis of Power Content Label Designs* by Wolfinger, Jan Felix. Retrieved from: http://hdl.handle.net/10161/3160,

[3] Massachusetts Energy and Environmental Affairs Information Disclosure Labels Retrieved from http://www.mass.gov/eea/energy-utilities-clean-tech/electric-power/electric-market-info/info-disclosure-labels.html

2.3 PEER Metrics for Assessing Electrical Power Supply Performance

The PEER rating system includes 68 criteria used to assess the electricity supply and delivery system for projects including campuses, municipalities, and commercial developments. These criteria include a set of performance metrics that are used to assess electricity suppliers in areas of clean energy, energy efficiency, and environmental impacts. The following six criteria represent frequently used and commonly available data that are used in the PSPI rating process:

Source Energy Intensity (SEI) in MMBtu per MWh

Carbon Dioxide Intensity (CO_2I) in lbs. per MWh

Nitrogen Oxide Intensity (NO_xI) in lbs. per MWh

Sulfur Dioxide Intensity (SO_2I) in lbs. per MWh

Water Consumption in gallons per MWh

Percent of Solid Waste Recycled

3. State Ratings

Each state is assessed based on the generation within its state boundaries using the most recent available data published by EIA[4]. States are awarded points based on performance for each of the six performance criteria mentioned above. The PSPI rating is a value between 0 and 100 that is equal to the sum of the points for the six criteria. These ratings range from 17 for Kentucky to 93 for Washington. The performance values for each of the six metrics along with the overall score for all 50 states can be found in Appendix A.

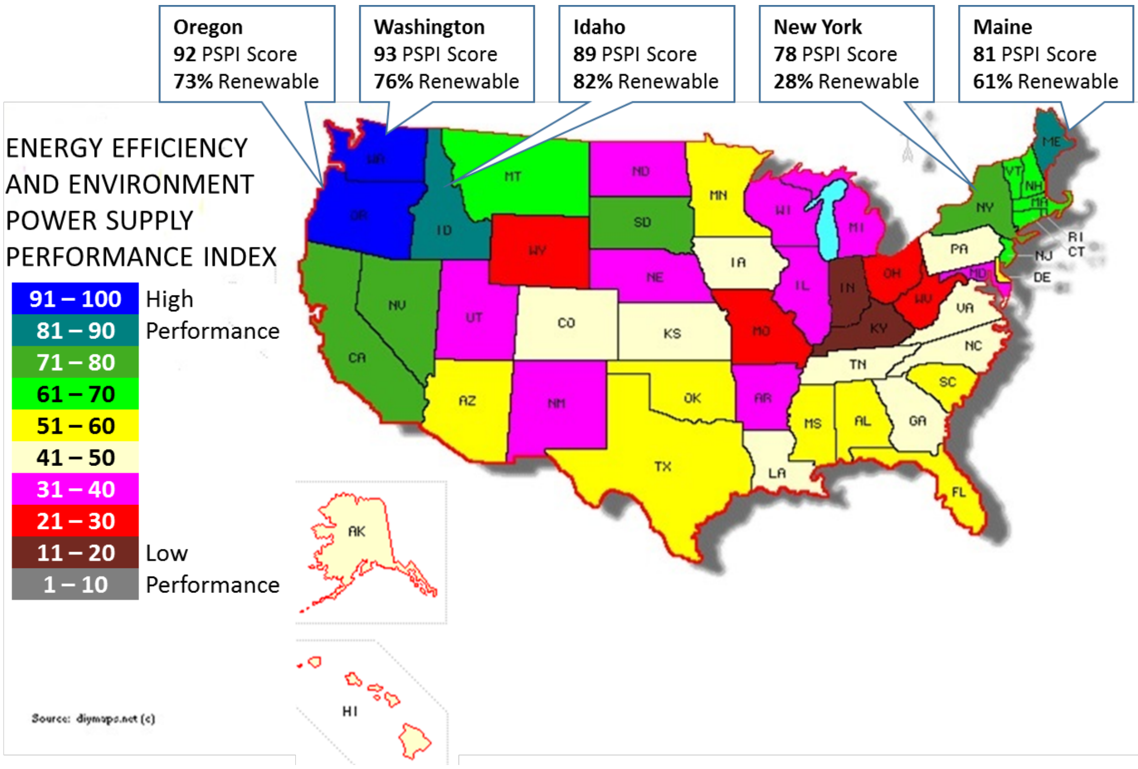
Table 1: PSPI for Top 10 States

	2014	
Rank	**State**	**Score**
1	Washington	93
2	Oregon	92
3	Idaho	89
4	Maine	81
5	New York	78
6	South Dakota	76
7	California	76
8	Nevada	70
9	Vermont	70
10	Rhode Island	67

[4] U.S. Energy Information Agency. *https://www.eia.gov/electricity/data/state* This report is based on data from 2014. The U.S. Energy Information Agency publishes annualized data approximately 15 months after the end of the year.

The top four states, scoring 81 or higher, supply efficient power with low emissions and little solid waste production. Many of the high performing states supply a majority of power from locally available renewables, specifically hydro-powered sources. The following map provides an overview of the performance across the United States, with the top five states highlighted.

Figure 2: PSPI State Ranking Map



A few states with substantial renewable generation only have average to poor overall performance. This is due to the poor performance of the other generation sources in their generation portfolio. These states (see Table 2) should consider the environmental impacts of their entire generation portfolio while progressing towards renewable power goals.

Table 2: PEER Power Supply Performance Index Compared to Percent Renewable

State	PEER Power Supply Performance Index	Percent Renewable
North Dakota	34	24%
Colorado	46	18%
Iowa	49	31%
Alaska	51	29%

The state PSPI results are offered as one tool to encourage a national discourse on electricity. Recently published goals for carbon reduction have made this an increasingly important topic.[5]

4. Supplier Ratings

A few leading electricity suppliers provide environmental performance information in their annual reports – for example, NextEra Energy Resources and Calpine.[6,7] These suppliers prioritize efficient and clean generation as key business drivers. The supplier scorecard in Table 3 provides a performance summary of the six key criteria and corresponding PSPI. The United States average data is included for comparison.

Table 3: PSPI Score for Suppliers

Criteria	Calpine	NextEra	U.S.
Source Energy Intensity (mmBTU/MWh)	7.8	5.4	8.8
CO_2 Intensity (lb/MWh)	1,041	323	1,318
SO_2 Intensity (lb/MWh)	0.005	0.14	2.10
NOx Intensity (lb/MWh)	0.13	0.10	1.25
Water Consumption (gallons/MWh)	148	206	459
Solid Waste Recycled	100%	73%	57%
PEER PSPI (out of 100)	**75**	**97**	**50**
% Renewable Generation	**5%**	**45%**	**13%**

The PSPI provides a means for these suppliers to stand out as high-performing, clean energy choices. With compelling performance data, customers in restructured markets are equipped to evaluate the energy efficiency and environmental impact of their supplier and seek contracts with cleaner competitors or pursue local generation.

5. How to Utilize the PSPI and PEER Rating System

Suppliers, customers, and other stakeholders to gain a competitive advantage, assist with securing more sustainable power at competitive prices, and evaluate the overall performance of the power supplied to the grid can utilize the PSPI and the PEER rating system. Professionals can leverage the PSPI and the PEER rating system to:

- Request power supply labeling and performance information from your existing or prospective power suppliers, including procurement document language and terms
- Compare performance of suppliers using the PSPI

[5] Executive Office of the President (2013). *The President's Climate Action Plan.* Retrieved from: http://www.whitehouse.gov/sites/default/files/image/president27sclimateactionplan.pdf

[6] *Calpine 2015 Annual Report* and *Calpine – Powering a Clean, Low-Carbon Future.* Retrieved from: http://s2.q4cdn.com/469362763/files/doc_financials/2015/2015-Annual-Report.pdf and http://www.calpine.com/media/Climate_Change.pdf

[7] NextEra Energy *Annual Report 2015*. Retrieved from: http://www.nexteraenergy.com/pdf/annual.pdf

- Review projects including campuses and municipalities using the PEER screening process that includes the energy efficiency and environment metrics from the PSPI.
- Join the PEER participation program and gain access to PEER tools for analyzing supplier power mixes, identifying generation portfolios that will achieve higher levels of performance, and evaluating the impact/benefits of installing cleaner local generation (e.g. solar PV or cogeneration)
- Complete training on the PEER rating system and become a facilitator of PEER projects.

At the end of this report, three case studies provide more insights into how the PSPI and PEER system have and can be used to improve sustainability of the electric power supply to states, municipalities, and campuses.

6. Call to Action

Consumers: Customers should request power supply labeling and performance information from existing or prospective power suppliers.

Policy Makers: State legislators and utility boards should understand the environmental impact of electrical power supplied to their constituents. They should enact policies and laws requiring power supply labeling that is clear and focused on outcomes by providing both energy mix and overall environmental performance. Municipal and Cooperative utilities should be held to the same reporting standards as investor owned utilities.

Municipal utilities and campus project operators: Operators of aggregated consumer groups including municipal utilities, cooperative utilities, and campuses should consider entering into unilateral contracts with suppliers to reduce the environmental impact of electricity consumption. These entities should also consider installing or facilitating installation of local clean energy sources. The PEER PSPI and its performance metrics provide a useful framework for comparing suppliers and understanding the benefits of moving to alternate clean energy suppliers.

Consultants/Engineers/Stakeholders: Many projects to improve electrical supply and delivery system resiliency are under consideration. Local, distributed generation for project resiliency can also improve overall environmental performance when high efficiency natural gas generation, district energy, and renewable generation are the used. The PSPI performance metrics and the PEER screening process provide a useful framework for assessing the potential benefits (and return on investment) offered by incorporating cleaner local generation into a project's overall electricity mix. Project managers should also consider entering into a PEER participation agreement to ensure that all aspects of sustainability are considered in project improvement plans.

Suppliers: Energy providers wishing to stand out as high-performing, clean energy choices should demand more transparency in the electricity supply industry. They can look to the PEER PSPI and its performance metrics to provide an independent third party assessment of their generation portfolio including a review the impact of each generation source on overall environmental performance.

Investors: The success of the GRESB program demonstrates the importance of sustainability to the investment community. Businesses investing in microgrids and other campus projects should consider electricity supply performance when comparing investment options. By investing in microgrids and campuses that are focused on sustainability, investors should reap long-term returns and public goodwill. Certification to the PEER standard demonstrates that a project successfully completed a comprehensive sustainability assessment and remains focused on continuous improvement and performance transparency. Consequently, investors are encouraged to seek out projects committed to the PEER standard.

Appendix A: State Performance Data

To construct the PSPI, the PEER program assessed all six key performance metrics for each state using publicly available information. The performance criteria shown below are for all of the generators in each state that report to the Energy Information Administration (EIA).

The following is a brief summary of the source data for each metric:

- Source Energy Intensity is calculated based on the 2014 total actual fuel consumption and electricity generation for each fuel type for each state. This data is provided by the Energy Information Association in the *Net Generation by State* and *Fossil Fuel Consumption by State* excel files.[8] It is assumed that natural gas and petroleum fuels have an energy content of 1,027 mmBTU/MCF and 5.8 mmBTU per barrel, respectively. The coal source energy intensity for each state is obtained from the EPA eGRID 2012 plant database.[9] Nuclear power is assigned an SEI of 10.5 mmBTU/MWh based on the 2010 Annual Energy Review (i.e. 8.44 quads divided by 807 million MWh). This data is also corrected for an average transmission and distribution loss of 6.6% from the Annual Energy Review.[10]
- CO_2, SO_2, and NOx is calculated using the EIA *Net Generation by State* and *Estimated Emissions by State* excel files. These indices are also adjusted for transmission and distribution losses. In addition, CO2 intensity for coal and natural gas generation is adjusted to account for greenhouse gases (primarily methane) released during extraction and transportation using the 2007 report 100 year Global Warming Potential of 25 times the methane mass released[11]. This equates to an additional 8 lbs/MMBtu for coal generation and 17 lbs/MMBtu for natural gas generation.
- Water Consumption estimates are obtained from the Argonne National Laboratory report, developing a Tool to Estimate Water Use in Electric Power Generation in the United States.[12] This index is also adjusted for transmission and distribution losses.
- Percent of Solid Waste Recycled is estimated based on the following assumptions:
  - Assume 43% of coal fired generation waste is recycled on average[13]
  - Assume 0% recycling for nuclear power and biomass fuel
  - Assume 100% recycling for all other fuels since they produce no appreciable solid waste

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[8] Energy Information Administration (2014). *Net Generation by State* and *Fossil Fuel Consumption by State.* Retrieved from: http://www.eia.gov/electricity/data/state/
[9] Environmental Protection Agency (2012). *Emissions and Generation Resource Integrated Database (eGRID).* Retrieved from: http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html
[10] Energy Information Administration (2011). *Annual Energy Review 2010* page 233 and Table 8. Retrieved from: http://205.254.135.24/totalenergy/data/annual/pdf/aer.pdf
[11] http://www3.epa.gov/climatechange/ghgemissions/gases/ch4.html
[12] Argonne National Laboratory (2010). *Developing a Tool to Estimate Water Use in Electric Power Generation in the United States ANL/ESD/11-2*. Retrieved from: http://www.ipd.anl.gov/anlpubs/2011/02/69392.pdf
[13] National Geographic (2011). *Seeking a Safer Future for Electricity's Coal Ash Waste.* Retrieved from: http://news.nationalgeographic.com/news/energy/2011/08/110815-safer-ways-to-reycle-fly-ash-from-coal/

Table 4: PEER Power Supply Performance Index Annual State Report

Rank	State	Score	SEI Index (MMBtu/ MWh)	CO_2 Intensity (lb./ MWh)	SO_2 Intensity (lb./ MWh)	NOx Intensity (lb./ MWh)	Water Intensity (Gal/ MWh)	Solid Waste Recycled (%)	Renew (%)	Gas (%)	Nuclear (%)	Coal (%)
1	WA	93	2.4	267	0.24	0.33	838	87	76	10	8	6
2	OR	92	2.2	355	0.57	0.49	702	95	73	21	0	5
3	ID	89	1.3	256	0.82	0.93	693	96	82	17	0	1
4	ME	81	2.8	657	2.04	1.45	533	74	61	33	0	1
5	NY	78	6.8	573	0.50	0.67	472	66	28	36	31	3
6	SD	76	3.3	680	2.81	2.09	671	86	71	4	0	24
7	CA	76	6.5	959	0.30	1.25	364	80	28	48	8	15
8	NV	70	7.2	1,164	0.55	1.02	339	90	18	64	0	18
9	VT	70	8.1	5	0.02	0.22	680	22	28	0	72	0
10	RI	67	8.0	1,232	0.75	0.63	175	97	4	95	0	0
11	NH	65	8.5	465	0.51	0.59	536	36	17	22	52	7
12	MA	64	8.2	1,002	0.78	1.01	334	73	8	59	18	9
13	MT	64	6.4	1,416	1.24	1.59	691	71	45	2	0	51
14	CT	62	9.3	622	0.23	0.57	424	49	4	44	47	2
15	NJ	60	9.6	696	0.16	0.54	405	50	2	46	46	4
16	FL	57	8.9	1,254	1.22	0.87	318	73	2	61	12	23
17	DE	56	9.5	1,450	0.45	0.73	213	93	2	82	0	11
18	TX	53	8.7	1,466	1.83	1.10	319	71	10	47	9	34
19	OK	52	8.2	1,582	2.44	1.65	312	75	20	38	0	43
20	AK	51	8.5	1,393	1.18	4.91	437	94	29	54	0	9
21	AZ	51	9.5	1,189	0.44	1.10	486	49	9	24	29	38
22	AL	51	9.2	1,142	2.06	0.82	477	52	8	32	28	32
23	MN	50	8.6	1,402	1.57	1.56	448	47	21	7	22	49
24	MS	50	9.0	1,168	4.11	1.07	335	68	3	59	19	19
25	NC	49	9.4	1,156	1.22	1.09	501	44	6	22	32	38
26	SC	49	10.1	834	1.20	0.47	562	27	5	12	53	29
27	IA	49	7.7	1,696	4.06	1.74	387	58	31	2	7	59
28	KS	48	9.1	1,556	1.24	1.25	424	50	22	3	17	58
29	GA	48	9.4	1,231	2.33	1.03	455	51	6	32	26	36
30	HI	47	7.9	1,664	4.21	5.15	369	88	13	0	0	15
31	VA	47	9.6	1,080	2.01	1.17	482	41	6	27	39	27
32	CO	46	8.6	1,772	1.52	1.92	393	65	18	22	0	60
33	TN	45	9.4	1296	2.52	0.68	601	39	13	8	35	45
34	PA	44	9.8	1131	2.47	1.33	478	43	4	24	36	36
35	LA	43	9.6	1430	2.44	1.72	343	70	4	54	17	18
36	IL	40	10.6	1164	2.14	0.65	548	27	5	3	48	43
37	AR	38	9.6	1498	3.16	1.61	525	43	7	16	24	54
38	NM	38	9.7	1899	0.99	3.32	385	64	9	28	0	63
39	WI	35	9.6	1777	3.52	1.47	509	47	9	13	15	61
40	MD	35	10.4	1357	2.75	1.39	563	34	7	7	38	47
41	ND	34	9.0	2035	3.31	2.85	477	57	24	1	0	75
42	UT	34	9.8	2007	1.12	2.99	465	56	4	19	0	76
43	NE	33	10.1	1615	3.37	1.59	535	38	10	1	26	63
44	MI	31	10.1	1481	5.03	1.70	507	40	8	12	29	49
45	OH	29	10.3	1804	5.20	1.56	474	49	2	18	12	67
46	WY	27	10.0	2326	1.99	2.27	489	50	11	1	0	87
47	WV	26	10.3	2230	2.65	1.70	528	45	3	1	0	96
48	MO	23	10.8	2075	3.64	1.81	524	42	2	5	11	82

49	IN	19	10.5	2204	5.32	2.33	481	51	4	8	0	85
50	KY	17	10.9	2317	4.51	2.09	539	47	4	3	0	92

Appendix B: Precedence for the PSPI

The following leading institutions have established metrics in the area of environment and energy efficiency, which served as the foundation for the PSPI. These standards identify performance metrics that can be utilized to compare electricity system performance in terms of clean energy and efficiency. This includes two examples of state power labeling.

- The California legislature[14] mandates **Power Content Labeling** recognizing that consumers needed greater transparency regarding the "sources of electricity that is put into the power grid." Today in CA "Each electricity supplier must display information about the energy resources represented by their contracts with electricity generators."
- The Massachusetts Energy and Environmental Affairs department's electric restructuring regulations require competitive suppliers to disclose the following information to customers: (1) regional average fuel characteristics; (2) certain applicable emission rates; and (3) regional average labor characteristics.[15] Suppliers should use the information provided below in preparing their information disclosure labels.
- The **Energy Information Association** (EIA) requires large power plants to report performance data monthly including fossil fuel energy consumption and emissions data.[16]
- In 2000, **Pace University** developed an environmental performance rating known as the Power Score Card for suppliers of electricity.[17] It considers environmental (carbon dioxide, acid rain, particulate and toxic emissions), water (consumption and pollution), and land impacts (footprint and waste).
- In its ENERGY STAR rating system[18], the **U.S. Environmental Protection Agency** (EPA) defines a new metric for measuring electricity system efficiency: source energy index (SEI).[19] By determining the total energy in MMBtu consumed to deliver a MWh of electricity to a building, this electric system metric accounts for the losses in electricity generation, transmission, and distribution. EPA uses an average SEI for all buildings to provide an effective building benchmarking system.

[14] California Public Utility Commission (2009). *Legislation AB 162 and Senate Bill 1305*. Retrieved from: http://www.energy.ca.gov/sb1305/power_content_label.html
[15] Massachusetts Energy and Environmental Affairs 220 C.M.R.§11.06, Retrieved from, http://www.mass.gov/eea/energy-utilities-clean-tech/electric-power/electric-market-info/info-disclosure-labels.html
[16] Energy Information Administration (2011). *Net Generation by State* and *Fossil Fuel Consumption by State.* Retrieved from: http://www.eia.gov/electricity/data/state/
[17] Pace Energy Project (2005). *Power Scorecard: Using Consumer Choice for a Better Environment.* Retrieved from: www.powerscorecard.org/scorecard
[18] U.S. Environmental Protection Agency (2013). *ENERGY STAR*. Retrieved from: www.energystar.gov
[19] U.S. Environmental Protection Agency (2011). *Understanding Source and Site Energy.* Retrieved from: www.energystar.gov/index.cfm?c=evaluate_performance.bus_benchmark_comm_bldgs

- EPA also created an **Emissions and Generation Resource Integrated Database** (eGRID) that tracks key emissions intensities (in pounds or tons per MWh), including carbon (CO_2), sulfur dioxide (SO_2), and nitrogen oxide (NO_X), for all generators in the United States. Electricity generators are required to supply this information to the Energy Information Association. EPA analyzes the EIA data and summarizes/aggregates the data by state, grid region, power plant and generating company in the online database.[20]
- The **Electric Power Research Institute** (EPRI) sponsored research on the dependency of the electricity supply and availability of clean water,[21] identified major water-consuming power plant types and estimated typical water consumption per unit of generation for each plant type. Additionally, the National Renewable Energy Laboratory determined the water consumption per kWh of energy consumed for each state, assuming that the states did not import or export.[22]
- The **Natural Resources Defense Council** (NRDC) provides benchmarking for major electricity suppliers that includes CO_2e, NO_X, HG (mercury), and SO_2.[23]
- Texas retail electricity supply rules, subchapter R customer protection, require energy suppliers to provide the percentage of renewable generation content.[24]
- Senator Bingaman established legislation for a national **Clean Energy Standard Act of 2012** that would require the reporting of the percentage of clean energy sold by each power supplier where clean energy is defined as including qualifying renewable generation and fossil generation with a carbon foot print of less than 0.82 metric tons of carbon per MWh.[25]

[20] U.S. Environmental Protection Agency (2013). *Emissions and Generation Resource Integrated Database (eGRIDweb).* Retrieved from: http://cfpub.epa.gov/egridweb/

[21] Electric Power Research Institute (2002). *Water and Sustainability (Volume 3): U.S. Water Consumption for Power Production – The Next Half Century.* Retrieved from: http://mydocs.epri.com/docs/public/000000000001006786.pdf

[22] National Renewable Energy Laboratory (2003). *Consumptive Water Use for U.S. Power Production.* Retrieved from: www.nrel.gov/docs/fy04osti/33905.pdf

[23] Natural Resources Defense Council (2008). *Benchmarking Air Emissions of the 100 Largest Electric Power Producers in the U.S.* Retrieved from: www.nrdc.org/air/pollution/benchmarking/db/rank.asp?t=e&s=11&d=-1

[24] Texas Public Utility Commission (2010). *Chapter 25. Substantive Rules Applicable to Electricity Service Providers.* Retrieved from: http://www.puc.state.tx.us/agency/rulesnlaws/subrules/electric/25.475/25.475.pdf

[25] Senate of the United States (2012). *Clean Energy Standard Act of 2012.* Retrieved from: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=b3580f37-ec8c-4698-a635-3e19f9815b9a

Case Study 1: States Can Leverage PEER to Improve Power Performance

How might a state utilize the PSPI to improve power performance? One example is the state of Georgia. In 2011, Georgia received a Power Supply Performance Index score of 42, ranking 33rd out of 50 states. In 2014, the state of Georgia received a PSPI score of 48, ranking 29th out of 50 states. Georgia demonstrated great progress by incorporating more combined cycle combustion turbine (CCCT) natural gas into their power supply portfolio and reducing its reliance on coal from 48% of its generation to 36%. In the future, Georgia could significantly raise its score by continuing to move towards CCCT gas generation and other cleaner energies.

The performance data shown in Table 4 provides an energy mix breakdown of the performance metrics used to derive Georgia's PSPI score of 48.

Table 5: PEER Power Supply Performance Index: Georgia 2014 (Score 48)

Source	%	SEI MMBtu/MWh	CO_2 lbs/MWh	NO_X lbs/MWh	SO_2 lbs/MWh	Water gals/MWh	Waste % recycled
Gas CCCT	32.4%	7.4	870	0.2	0.0	150	100%
Nuclear	25.7%	10.5	0	0	0	600	0%
Coal	35.8%	10.2	2,200	1.8	4.5	500	43%
Biomass	3.3%	0	0	7.2	16.0	600	100%
Hydroelectric	2.4%	0	0	0	0	1,000	100%
Other	0.4%	7.0	4,000	3.8	9.9	270	100%
Overall Performance*	**100%**	**9.35**	**1,231**	**1.03**	**2.33**	**455**	**51%**

* Overall Performance values includes adjustments for grid losses and methane leakage

By understanding the current performance and pursuing several cost effective improvements, Georgia can continue to improve their PSPI score by increasing generation from gas CCCT, solar, and wind sources. With the improvements summarized in Table 5, Georgia's PSPI score would improve from 48 to 65 – placing Georgia in the top quartile of states as measured by the index.

Table 6: Description of Improvements and Impact on Score for Georgia

Improvement Measures	Added Points
Current Score	**48**
Increase use of existing idle cleaner generation by improving capacity factor for 8,400 MW of existing CCCT gas generation from 50% to 60% to displace a portion of coal generation.	3.5
Adding 2,000 MW of new CCCT gas generation @ 80% capacity factor to displace a portion of coal generation.	7
Adding 1,600 MW of wind generation @ 40% capacity factor to displace coal generation. This would bring Georgia in line with the national average for wind generation.	4.5
Adding 500 MW of solar PV generation @ 22% capacity factor to displace a portion of coal generation. This would bring Georgia in line with the national average for solar generation.	1
Improved Score	**65**

Table 6 provides a breakdown of the revised energy mix and improved performance with the proposed improvements. Greenhouse gas emissions have been reduced by approximate 30% and other air emissions have been reduced by approximately 40%.

Table 7: PEER Power Supply Performance Index: Georgia w/ Improvements (Score 65)

Source	%	SEI MMBtu/MWh	CO_2 lbs/MWh	NO_X lbs/MWh	SO_2 lbs/MWh	Water gals/MWh	Waste % recycled
CCCT Gas	48.9%	7.4	870	0.2	0.0	150	100%
Nuclear	25.7%	10.5	0	0.0	0.0	600	0%
Coal	10.5%	10.5	2,200	1.8	4.5	500	43%
Wind	4.3%	0	0	0.0	0.0	0	100%
Biomass	3.3%	0	0	7.2	16.0	600	0%
Hydroelectric	2.4%	0	0	0.0	0.0	1000	100%
Solar PV	0.7%	0	0	0.0	0.0	30	100%
Overall *	**100%**	**8.25**	**885**	**0.65**	**1.29**	**367**	**63%**

* Overall Performance values includes adjustments for grid losses and methane leakage

Additional improvements to improve the Georgia PSPI score include enacting policies that:

- Increase recycling of coal ash
- Reduce NO_x and SO_2 emissions from coal generation and biomass generation
- Encourage private investment in local renewable generation

With the PSPI, each state is able to review the impact of each generation source and determine the best course of action for improving their energy efficiency and environmental performance. For example, some states will find that they are behind in developing renewable energy generation. Others will find that they have idle high efficiency gas generation that is available to offset generation from less environmentally friendly fossil fuel generation. For some states, tighter controls on the SO_2 and NOx emissions performance for fossil generation could significantly improve overall state performance.

Case Study 2: Leveraging the PSPI in Electricity Procurement Contracting

In November 2012, the City of Chicago approved Community Choice Aggregation (CCA), an Illinois law that enables cities to procure electricity on behalf of their residential and small commercial residents. Leveraging the PEER Power Supply Performance Index, Chicago narrowed the field of prospective candidates based on a commitment to put generation with higher energy efficiency and less harmful emissions into the grid.

The selected supplier, Integrys, partnered with NextERA to gain access to a combined cycle combustion turbine/cogeneration power plant that was only operating at 30% of its full capacity. Together, Integrys and NextERA put about 6 million MWh of power into the grid to meet the needs of residential and small businesses. Table 7 provides a summary of the power supply mix for Chicago CCA residents and small businesses compared to the Illinois Power Agency (IPA), which procures power for customers that do not select a competitive supplier.[26] Table 8 summarizes benefits of the improved energy efficiency and environmental performance for the contracted power mix.

Table 8: IPA vs. CCA Supply Mix 2013

Fuel/Plant	IPA	CCA
Nuclear	35%	0%
Hydroelectric	1%	0%
Wind	4%	5%
Coal	43%	0%
Combined Cycle Gas	13%	95%
Simple Gas	4%	0%
Total	100%	100%
Power Supply Performance Index	44	73

Table 9: Estimated Annual Savings

Metric	Baseline (IPA)	Integrys Contract	Total Reduction	Equivalent
Source Energy	10.5 MMBtu/MWh	7.5 MMBtu/MWh	15,000,000 mmBTU	~ 30% of homes and business transitioning to net zero
CO_2 Emissions	1,251 lbs/MWh	1,007 lbs/MWh	600,000 tons	~ 17% improvement, equivalent to 125,000 cars*
NO_x Emissions	1.1 lbs/MWh	0.16 lbs/MWh	2,200 tons	~ 87% improvement, equivalent to 240,000 cars*
SO_2 Emissions	2.4 lbs/MWh	0.01 lbs/MWh	6,000 tons	The retired Fisk power station in Chicago emitted 4,000 tons / year
* EPA reports that cars and light trucks emit 18 lbs of NOx and 9,737 lbs. of CO2 annually on average[27]				

Municipalities, campuses, and large industrial / commercial customers should consider entering into unilateral contracts with suppliers to reduce the environmental impact of electricity consumption. The PEER PSPI and its performance metrics provide a useful framework for comparing suppliers and understanding the benefits of moving to alternate clean energy suppliers.

[26] ComEd Environmental Disclosure Statement for the twelve months ending June 30, 2012, provided in customer electricity bills. Carbon=1,096, NOx=0.98, & SOx=2.8 lbs./MWh.
[27] U.S. EPA. (2008). "Average Annual Emissions and Fuel Consumption for Gasoline-Fueled Passenger Cars and Light Trucks." Retrieved from: https://www3.epa.gov/otaq/consumer/420f08024.pdf

Case Study 3: Leveraging the PEER Screening Process to Assess Local Generation

The PEER screening process for campuses includes a microgrid analysis process for determining whether a business case exists for adding distributed resources including local electricity generation and storage capabilities. The analysis also examines the net impact of adding local capabilities on the environmental performance of the project's overall energy mix.

To illustrate this process, a case study has been prepared for a hypothetical campus in Massachusetts. The case study is based on a typical load profile for a medical campus, actual real time pricing rates, and actual default supplier rates for electricity. The project has an overall annual electrical load of 74,000 MWh and a peak annual demand of 15 MW.

Based on an analysis of potential savings in energy cost and demand charges, 4,000 kW of high efficiency baseload CHP generation, 5,000 kW of high efficiency supplemental CHP generation, and 1,000 kW of solar generation are to be added to this campus. This should support islanding capability for the majority of the campus in the event of a grid outage while providing a hedge to enter the real time price electricity market. The microgrid model dispatches the new generation based on real time price signals and demand charge reduction. An hour-by-hour analysis determines the operating profile for the local generation during the course of the year. Based on this analysis, Table 9 below summarizes the predicted energy mix provided by bulk power and local generation for the year. The local generation supplies 50% of the total required electricity for the campus.

Table 10: Estimated Annual Generation Mix for Campus

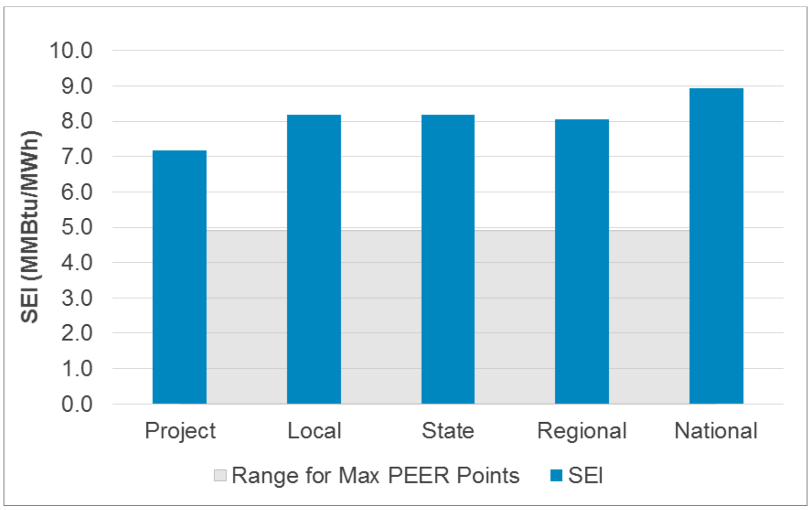
PURCHASED (bulk grid)	Use State Energy Mix for Purchased Electricity	
Coal and Petroleum	7%	based on state mix
Simple Natural Gas	0%	based on state mix
High Efficiency Natural Gas	29%	based on state mix
Nuclear	9%	based on state mix
Hydro Electric	1%	based on state mix
Wind and Solar PV	1%	based on state mix
Other Renewable	2%	based on state mix
LOCAL (project or tenant operated)		
CHP (to displace boilers)	21%	
CHP (to generate electricity and thermal)	26%	
High Efficiency Natural Gas	0%	
Other Natural Gas	0%	
Wind and Solar PV	3%	
Biomass	0%	
Geothermal	0%	

This energy mix is analyzed using the PEER PSPI methodology to determine the overall energy efficiency and environment performance for the project with the local generation. The performance for each of the six PSPI metrics is compared to local, state, regional, and national benchmarks in tabular and graphical displays. The screening results are provided below for the hypothetical medical campus in the New England area. Note that local and state benchmarks are equivalent since the campus is located in a restructured state for which the state energy mix approximates the electricity provided by default suppliers in the campus location. The new project energy mix compares favorably to the default energy mix provided by the local supplier as shown in table 10. Figure 3 is an example of a benchmarking chart from the PEER screening process:

Table 11: Comparison of Project Performance to Benchmarks

	Project	Local	State	Regional	National
SEI (MMBtu/MWh)	7.17	8.19	8.19	8.06	8.94
CO_2 (lbs/MWh)	940	1002	1002	763	1324
NO_x (lbs/MWh)	0.59	1.01	1.01	0.79	1.25
SO_2 (lbs/MWh)	0.39	0.78	0.78	0.98	2.15
Water (gal/MWh)	215	334	334	426	458
Waste (% recycled)	86%	73%	73%	54%	58%

Figure 3: Benchmarking Chart for Project



It should be noted that this case study is based on a state that is already in the top quartile for national performance. In many states, adding local high efficiency and renewable distributed generation is a very effective strategy to dramatically improve overall energy efficiency and environmental performance for a project's energy mix. The PEER screening process using the PSPI methodology provides a means to assess the potential benefits (and return on investment) offered by incorporating local generation into a project's overall electricity mix.