

# **An Energy Scorecard for the American States**

## **States ranked according to energy, economy and environment**

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# An Energy Scorecard for the American States

States ranked according to energy, economy and environment

## Executive Summary

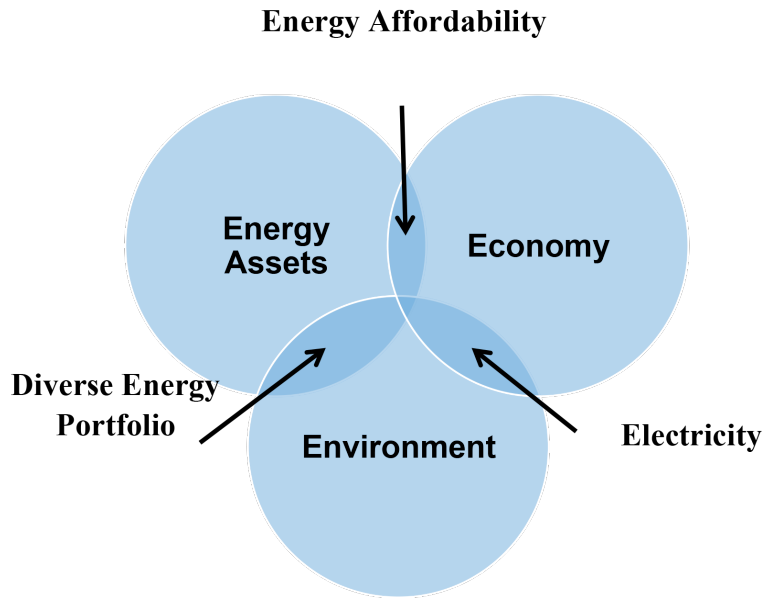
The impact of climate change continues unabated, and devastation due to drought, fires, flooding, and severe weather is becoming more pronounced. Crafting policy to combat the effect of climate change remains a challenge due to its connections with energy markets and policy. Addressing this public policy challenge requires an understanding of relationships between energy and environmental outcomes. This inaugural *Energy Scorecard for the American States*, provides data and a ranking on five criteria that capture different facets of a state's energy footprint.

1. energy **assets** and production
2. **economy** and energy spending
3. **diverse** energy portfolio
4. **affordability** for residents
5. ability to meet **electricity** needs
6. **environment** and carbon emissions

The **top five** states with the best ratings for these factors were **Illinois, Washington, Oregon, Colorado, and Pennsylvania** with Illinois ranked number one due to its diverse energy portfolio and service-based economy. The **bottom five** states were **Louisiana, Indiana, Mississippi, Kentucky, and Missouri**. Kentucky and Missouri are both ranked 49, but for different reasons. Kentucky ranked poorly for inefficient energy use, an unbalanced portfolio and carbon-intensive economy, whereas Missouri ranked 49<sup>th</sup> for its lack of energy assets, unbalanced portfolio and high energy costs for households. It is hoped that the states will use these rankings to assess and reflect on their own performance and identify ways to improve their natural environments and wellbeing of citizens. *The Baker Center appreciates the financial support of the Tennessee Valley Authority in conducting this research.*

## Introduction

Energy, economic performance, and environmental quality are fundamentally linked. Energy industries such as oil and natural gas drilling provide valuable jobs and tax revenues, but those same jobs can also harm our environmental quality through the process of resource extraction and the generation of electricity. States with high service sector economies avoid some energy-related impacts to the natural environment but also tend to put a greater energy burden on household finances. Lower energy burdens facilitate the attraction of business but also encourage more energy use and with it the potential for environmental degradation. These relationships manifest in different degrees based on the characteristics of the local economy, the pre-existing natural resource base, local economic and environmental policies, and the income of local households. Six key features of the energy-economy-environment nexus are identified in the figure below and detailed in the following section. These metrics are used to characterize the relationships in each state. Difficult tradeoffs are commonplace with states performing well in some metrics and poorly



## Six Key Features of the Energy- Economy- Environment Nexus Characterize Difficult Tradeoffs Facing States

in others. These metrics are then used to provide a comprehensive assessment of each state's overall performance – an *Energy Scorecard for the American States*.

### Data and Core Metrics

Primary data for the study are from the U.S Energy Information Administration (EIA) and its State Energy Data System (SEDS).<sup>1</sup> An important benefit of using these data is that they are well documented, easily accessed, and widely used. SEDS provides state-level estimates of energy consumption, prices, expenditures and production from 1960 to 2013. Other data such as state gross domestic product (GDP) and per capita personal income of each state are from the Federal Reserve Economic Data (FRED) of the Federal Reserve Bank of St. Louis, another widely-used source.<sup>2</sup> The following six core metrics are used to rank all fifty states.<sup>3</sup>

1. **Energy Assets:** Measures how much energy the state produces and serves as a proxy for the amount of mineral resources and renewable (solar, wind, etc.) assets a state possesses. *Energy production estimates* (table P2 in SEDS) provide energy production by source in trillions of BTU. This includes energy production from hydroelectric power, biomass, geothermal, solar/PV, wind energy, biofuels, and fossil fuel production (coal, natural gas and crude oil). Larger values for the energy assets metric represent states with robust and stable energy production capacity.
2. **Economy:** Energy's role in the state economy is measured by the ratio of state GDP to total energy expenditures. Expenditure data can be found at *Primary energy, electricity, and total energy price and expenditure estimates* (table ET1 in SEDS) which is the same source as the affordability metric. Larger values for this metric reflect states that can produce more goods and services with the same energy expenditure.
3. **Diverse Energy Portfolio:** States that consume energy from a diversity of sources are better

1 The State Energy Data System can be found at <http://www.eia.gov/state/seds/seds-data-complete.cfm?sid=US>. Data from the EIA database but not from SEDS will be identified in footnotes.

2 <https://research.stlouisfed.org/fred2/>.

3 The District of Columbia and Puerto Rico are excluded from our analysis.

prepared to handle shocks than states that consume from only one source. For example, unexpected changes in fossil fuel prices and environmental variability that disrupts renewable energy generation can be damaging to state economies that rely on a single fossil fuel, renewable technology for energy needs. *Primary energy consumption estimates* (table CT in SEDS) provides energy consumption estimates by source in trillions of BTU. Diversity is defined as the percentage of a state's energy consumption supplied from sources other than its primary source. For example, if 40 percent of a state's energy consumption is supplied by coal and no other single source (natural gas, petroleum, hydro, nuclear and wind/solar) is responsible for a larger percentage, that state receives a diversity score of 60. Larger values of the diversity metric suggest more balanced energy consumption from a variety of sources.

4. **Affordability:** Affordability is a measure of the energy burden for state residents and is defined by the ratio of personal income per capita to residential energy expenditures.<sup>4</sup> *Primary energy, electricity, and total energy price and expenditure estimates* (table ET1 in SEDS) shows the expenditure estimates by source of energy in dollars per million BTU.<sup>5</sup> Per capita personal income data are from *FRED*. Larger numbers reflect states where the cost of energy is lower indicating a relatively lower cost of living in these states.
5. **Electricity:** Electricity is a measure of a state's ability to generate its own power to meet the demands of residents and is defined by the ratio of net electricity generation to electricity retail sales. *Retail sales of electricity by state by sector by provider* shows amounts of retail electricity sold by each sector.<sup>6</sup> Larger net electricity generation indicates a comparative electricity generation advantage while larger retail electricity sales represent larger average electricity consumption. A ratio greater than 1 indicates states that are net electricity exporters, i.e. they generate more electricity than they consume.
6. **Environment:** Each state's environmental performance is measured by carbon intensity of the state economy, defined by the ratio of state GDP to total carbon dioxide emissions from fossil fuel consumption. *Carbon dioxide emissions from fossil fuel consumption by fuel and sector*<sup>7</sup> include total carbon dioxide emissions in metric tons as well as the source of the emissions by fuel type and sector. State GDP data are from *FRED*. This metric represents how much the state economy depends on industries which emit carbon dioxide. Higher values indicate states where economic growth generates relatively less carbon dioxide.

## State Rankings

### Method

Each state is ranked based on raw values calculated from the definition of each core metric:

- 1 means the best performing state
- 50 is the worst performing state

<sup>4</sup> Note that energy expenditure is the amount of energy consumed multiplied by the price.

<sup>5</sup> See [http://www.eia.gov/state/seds/sep\\_prices/notes/pr\\_technotes.pdf](http://www.eia.gov/state/seds/sep_prices/notes/pr_technotes.pdf) for details of price and expenditure estimates.

<sup>6</sup> For details see <http://www.eia.gov/electricity/data/eia861/index.html>.

<sup>7</sup> For details see <http://www.eia.gov/environment/emissions/state/>. Due to the timing of data releases by EIA, environment metrics are based on the previous year's carbon dioxide data. For example, the 2013 environment metric for each state is calculated using carbon dioxide estimates from 2012.

A state's ranking under each core metric is then averaged to provide a comprehensive state ranking. This is the simplest and most intuitive way to rank the overall performance of each state.

## Results

The top five states are **Illinois, Washington, Oregon, Colorado, and Pennsylvania**. Illinois is ranked number one due to its diverse energy portfolio and service-based economy in spite of its relatively expensive energy. Efficient energy usage and a low carbon economy take Washington and Oregon to the second and third positions respectively. Fourth ranked Colorado benefited from abundant energy assets and an energy-efficient economy. In spite of its relatively expensive energy, Pennsylvania is ranked fifth due to its large energy assets, balanced energy sources, and abundant electricity generation.

The bottom five states are **Louisiana, Indiana, Mississippi, Kentucky, and Missouri**. Even though there are large energy assets in Louisiana, it is ranked 46<sup>th</sup> due to its inefficient energy usage and a carbon-intensive economy. Low energy affordability and a carbon intensive economy in Indiana lead the state to 47<sup>th</sup> in the ranking. Mississippi is ranked 48<sup>th</sup> because of its inefficient energy usage and a carbon-intensive economy (similar to neighboring Louisiana). Lastly, Kentucky and Missouri are jointly ranked at 49. In spite of its large energy assets, Kentucky performed poorly due to its inefficient energy use, unbalanced energy portfolio and carbon-intensive economy. In contrast, Missouri is ranked 49<sup>th</sup> due to a lack of energy assets, unbalanced energy portfolio, and a large energy burden on households.

### 2013 Overall Rankings

|    | Overall Ranking | Energy Assets | Economy | Diversity | Affordability | Electricity | Environment |
|----|-----------------|---------------|---------|-----------|---------------|-------------|-------------|
| IL | 1               | 9             | 8       | 6         | 41            | 10          | 21          |
| WA | 2               | 21            | 6       | 24        | 27            | 16          | 5           |
| OR | 3               | 32            | 10      | 18        | 21            | 13          | 6           |
| CO | 4               | 7             | 9       | 14        | 24            | 34          | 23          |
| PA | 5               | 3             | 20      | 9         | 46            | 8           | 29          |
| CT | 6               | 40            | 3       | 32        | 25            | 21          | 2           |
| NM | 7               | 10            | 30      | 26        | 13            | 7           | 40          |
| UT | 8               | 17            | 17      | 33        | 15            | 11          | 34          |
| AR | 9               | 15            | 39      | 4         | 20            | 12          | 38          |
| IA | 10              | 24            | 31      | 1         | 19            | 18          | 37          |
| NY | 11              | 22            | 1       | 23        | 48            | 38          | 1           |
| NH | 12              | 42            | 23      | 43        | 11            | 5           | 11          |
| AZ | 13              | 28            | 19      | 22        | 34            | 9           | 25          |
| DE | 14              | 49            | 5       | 25        | 5             | 47          | 13          |
| NE | 15              | 36            | 26      | 16        | 12            | 20          | 36          |
| NC | 15              | 27            | 15      | 12        | 42            | 35          | 15          |
| SD | 15              | 39            | 33      | 3         | 4             | 41          | 26          |
| VA | 15              | 20            | 13      | 17        | 38            | 46          | 12          |
| KS | 19              | 23            | 34      | 20        | 18            | 17          | 35          |
| CA | 20              | 11            | 2       | 38        | 49            | 44          | 4           |

|    |    |    |    |    |    |    |    |
|----|----|----|----|----|----|----|----|
| AL | 21 | 14 | 43 | 11 | 32 | 6  | 43 |
| WY | 21 | 2  | 46 | 49 | 1  | 1  | 50 |
| MD | 23 | 38 | 7  | 19 | 30 | 50 | 7  |
| OK | 23 | 5  | 36 | 31 | 23 | 15 | 41 |
| WI | 25 | 37 | 21 | 2  | 33 | 36 | 24 |
| MT | 26 | 19 | 45 | 35 | 7  | 4  | 45 |
| MN | 27 | 34 | 16 | 13 | 29 | 45 | 19 |
| ND | 27 | 8  | 48 | 47 | 2  | 3  | 48 |
| VT | 29 | 46 | 37 | 46 | 6  | 14 | 8  |
| MI | 30 | 26 | 25 | 5  | 44 | 32 | 28 |
| NV | 30 | 47 | 14 | 34 | 17 | 31 | 17 |
| OH | 32 | 16 | 24 | 8  | 45 | 39 | 30 |
| ID | 33 | 44 | 38 | 7  | 10 | 48 | 16 |
| RI | 34 | 50 | 12 | 40 | 9  | 43 | 10 |
| WV | 35 | 4  | 44 | 50 | 16 | 2  | 49 |
| MA | 36 | 45 | 4  | 29 | 37 | 49 | 3  |
| SC | 36 | 25 | 40 | 21 | 31 | 19 | 31 |
| GA | 38 | 29 | 22 | 15 | 43 | 37 | 22 |
| NJ | 39 | 35 | 11 | 36 | 40 | 40 | 9  |
| TN | 40 | 30 | 28 | 10 | 35 | 42 | 27 |
| HI | 41 | 48 | 29 | 48 | 8  | 27 | 14 |
| FL | 42 | 31 | 18 | 28 | 47 | 33 | 18 |
| AK | 43 | 13 | 42 | 45 | 3  | 30 | 44 |
| TX | 44 | 1  | 32 | 42 | 50 | 24 | 32 |
| ME | 45 | 43 | 47 | 41 | 14 | 23 | 20 |
| LA | 46 | 6  | 50 | 39 | 26 | 22 | 47 |
| IN | 47 | 18 | 35 | 30 | 39 | 29 | 42 |
| MS | 48 | 33 | 49 | 27 | 22 | 26 | 39 |
| KY | 49 | 12 | 41 | 44 | 28 | 28 | 46 |
| MO | 49 | 41 | 27 | 37 | 36 | 25 | 33 |

## Raw Values

### *A National View*

A closer look at the six metrics across all states from 2002 to 2013 reveals several statistically significant relationships that characterize the connection between energy, economic performance, and the environment.

1. **↑ Economy - ↑ Environment:** States with more efficient energy usage also tend to be less carbon intensive. For example New York, California and Connecticut score highest on the economy metric and are also in the top five based on the environment metric. Likewise, Louisiana, Mississippi, and North Dakota score lowest on the economy metric and are also in the bottom decile based on the environment metric.
2. **↑ Affordability - ↑ Electricity:** States that generate more electricity than they consume tend to have a lower cost of energy. For example Wyoming and North Dakota are in the top three based on electricity self-sufficiency and also have the lowest energy burden for state residents. Residents tend to spend a larger percentage of their income on energy expenditures in states like Maryland and Massachusetts that rely on inter-state electricity markets to fulfill their electricity needs.
3. **↑ Environment - ↓ Electricity:** States that generate more electricity than they consume tend to be more carbon intensive. For example, Wyoming, West Virginia, and North Dakota generate three times more electricity than they consume but also produce the most CO<sub>2</sub> per dollar of state GDP generated. States like New York and Connecticut produce far fewer tons of CO<sub>2</sub> per dollar of GDP generated but also rely on inter-state electricity markets to fulfill their electricity needs.
4. **↑ Electricity - ↓ Diversity:** States that generate more electricity than they consume tend to consume energy from a limited number of sources. For example Wyoming, West Virginia and North Dakota score highest on the electricity metric but have the least diverse energy portfolios. Likewise, Maryland, Massachusetts, and Idaho score lowest on the electricity metric but are more diverse than the national average.

### *Tennessee and Bordering States*

Tennessee and its bordering states experienced a mix of increases and decreases in their energy metrics.

Energy assets: Regional total energy production decreased from 1098.5 trillion BTU in 2011 to 1025.6 trillion BTU in 2013. Kentucky produced the most energy in all three years whereas Mississippi had the least energy assets in each year. The decreasing trend in the regional average over these years is limited to Kentucky, Mississippi, and Virginia. All other states exhibit an increasing trend in overall energy production.

Economy: The regional values increase from \$9.2 million in 2011 to \$9.8 million at 2013. As measured here, Virginia is the most efficient energy usage state in all years. Georgia and North Carolina are also ranked highly in the economy metric. Mississippi, on the other hand, is the least efficient state. Alabama and Kentucky also show low energy usage efficient.

Diversity of energy sources: Overall the region's energy portfolios are becoming more diverse. In 2012, an average of 36.4% of energy was supplied by a single source. In 2013, this metric had dropped to 35.3%. Kentucky and Alabama are the states most dependent on a single energy source whereas Arkansas and Tennessee have the most balanced energy consumption.

Affordability: On average, individuals in the region spent 11.5% of personal income on energy in 2011. By 2013, individuals spent 10.9% of personal income on energy, freeing up purchasing power to buy other goods and services. The most affordable energy is in Arkansas while Georgia is the least affordable.

Electricity: On average, this region generates more electricity than it consumes. This is especially true in Alabama and Arkansas. However, Tennessee, Virginia and Mississippi consume more electricity than they generate.

Environment: The region's overall carbon intensity improved over the three years. The average state GDP per million metric tons of CO<sub>2</sub> was 2,184.1 in 2011 but increased to 2,631.8 metric tons per million dollars in 2013. In fact, all states' environmental core metrics increased between 2011 and 2013. The state in the region with the least carbon intensive economy is Virginia whereas Kentucky has the most carbon intensive economy.

#### Core metric raw values for Tennessee and bordering states

|                | Year | Core Metrics                    |                         |               |                       |                           |                                                              |
|----------------|------|---------------------------------|-------------------------|---------------|-----------------------|---------------------------|--------------------------------------------------------------|
|                |      | Energy Assets<br>(trillion BTU) | Economy<br>(\$ million) | Diversity (%) | Affordability<br>(\$) | Electricity<br>(MWt hour) | Environment<br>(million \$/ million ton of CO <sub>2</sub> ) |
| Alabama        | 2011 | 1399.9                          | 7.5                     | 66.1          | 7.92                  | 1.76                      | 1345.2                                                       |
|                | 2012 | 1433.2                          | 7.7                     | 64.0          | 8.78                  | 1.77                      | 1422.7                                                       |
|                | 2013 | 1463.5                          | 8.1                     | 67.5          | 8.58                  | 1.71                      | 1540.0                                                       |
| Arkansas       | 2011 | 1391.2                          | 7.9                     | 69.4          | 14.98                 | 1.28                      | 1631.4                                                       |
|                | 2012 | 1472.8                          | 8.4                     | 69.3          | 17.09                 | 1.39                      | 1669.4                                                       |
|                | 2013 | 1439.1                          | 8.5                     | 69.8          | 15.83                 | 1.29                      | 1755.2                                                       |
| Georgia        | 2011 | 549.3                           | 10.1                    | 66.0          | 4.29                  | 0.91                      | 2443.4                                                       |
|                | 2012 | 555.1                           | 11.0                    | 66.4          | 4.67                  | 0.93                      | 2767.2                                                       |
|                | 2013 | 580.8                           | 11.4                    | 67.1          | 4.61                  | 0.93                      | 3294.3                                                       |
| Kentucky       | 2011 | 2840.9                          | 7.5                     | 46.8          | 10.14                 | 1.10                      | 1110.8                                                       |
|                | 2012 | 2391.2                          | 8.0                     | 51.1          | 11.37                 | 1.01                      | 1171.2                                                       |
|                | 2013 | 2138.3                          | 8.2                     | 49.8          | 10.44                 | 1.06                      | 1306.2                                                       |
| Mississippi    | 2011 | 441.1                           | 6.5                     | 62.1          | 13.23                 | 1.05                      | 1478.9                                                       |
|                | 2012 | 387.7                           | 6.8                     | 56.5          | 15.15                 | 1.13                      | 1634.8                                                       |
|                | 2013 | 409.3                           | 6.6                     | 62.0          | 14.03                 | 1.08                      | 1712.2                                                       |
| North Carolina | 2011 | 572.9                           | 12.0                    | 68.7          | 4.80                  | 0.90                      | 3090.1                                                       |
|                | 2012 | 561.0                           | 12.4                    | 68.6          | 5.27                  | 0.91                      | 3545.9                                                       |
|                | 2013 | 606.5                           | 12.5                    | 67.4          | 4.99                  | 0.97                      | 3882.6                                                       |

|                  |      |        |      |      |      |      |        |
|------------------|------|--------|------|------|------|------|--------|
| Tennessee        | 2011 | 507.1  | 8.9  | 67.9 | 7.06 | 0.81 | 2370.8 |
|                  | 2012 | 468.8  | 9.8  | 67.3 | 8.25 | 0.81 | 2551.2 |
|                  | 2013 | 544.8  | 10.0 | 67.8 | 7.94 | 0.82 | 2888.3 |
| Virginia         | 2011 | 1085.2 | 13.0 | 67.1 | 6.96 | 0.60 | 4002.2 |
|                  | 2012 | 1045.0 | 13.0 | 65.3 | 7.64 | 0.66 | 4455.7 |
|                  | 2013 | 1022.3 | 13.3 | 66.1 | 7.25 | 0.70 | 4675.3 |
| Regional Average | 2011 | 1098.5 | 9.2  | 64.3 | 8.7  | 1.05 | 2184.1 |
|                  | 2012 | 1039.4 | 9.6  | 63.6 | 9.8  | 1.08 | 2402.3 |
|                  | 2013 | 1025.6 | 9.8  | 64.7 | 9.2  | 1.07 | 2631.8 |

## Conclusion

Informed people inform the policy process. The data and rankings included in this annual report are intended to enlighten the current debate over energy and the environment and the appropriate role for public policy. While the report takes no stand on public policy, it does highlight fundamental tradeoffs and complementarities that may generate disparate views over energy and environmental policy. It also describes disparities in state and regional abilities to conform to potential changes in energy and environmental policy. Tracking energy and environmental outcomes across the American states will hopefully lead to improvements in our understanding of the complex relationships and competing incentives at play as America responds to tomorrow's energy and environmental challenges.

View a visual representation of the scorecard at <http://bakercenter.utk.edu/scorecard/>