

# ACEEE International Scorecard Self-Scoring Tool

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## Abstract

The *ACEEE International Scorecard Self-Scoring Tool* is an analytic tool that helps users develop a high-level snapshot of the overall energy efficiency of a nation, state, or province. The tool is based on the *2012 ACEEE International Energy Efficiency Scorecard*, which analyzed and ranked 12 of the world's largest economies on their overall energy efficiency. This tool allows users to perform similar analyses on countries of their choice and compare those results with the 12 economies analyzed by ACEEE. This tool is unique in that in addition to compiling key information specifically addressing the energy efficiency of a country, it provides complementary resources and analysis highlighting best practices and opportunities to improve while providing a benchmark with which a country's progress toward improving its energy efficiency can be compared.

## Introduction

Many factors indicate the level of energy efficiency in a country. While no single metric can provide a complete picture of a nation's energy efficiency, the combined total of a range of metrics provides an indication of overall energy efficiency in a country.<sup>1</sup> In order to provide a high-level summary of economy-wide energy efficiency we have identified 27 different metrics. In 2012 ACEEE published an analysis evaluating these 27 metrics in 12 of the world's largest economies. While these economies include much of the world, there are many countries, states, and provinces that were not evaluated. We have now developed an Excel-based analytical tool that allows users to create a similar analysis for a country of their choice: the *ACEEE International Scorecard Self-Scoring Tool (Self-Scoring Tool)*.

The *Self-Scoring Tool* is intended to be used by policymakers, stakeholders, and citizens interested in learning how efficiently energy is being used in their countries compared to other nations. This tool allows users to input the qualitative and quantitative data needed to score results in each of the 27 metrics and provides sector scores and a total score out of 100 possible points. These results allow users to compare the overall energy efficiency in their countries with 12 of the world's largest economies analyzed in the *2012 ACEEE International Energy Efficiency Scorecard (2012 International Scorecard)* and rely on the same methodology published in that report. The 27 metrics and the maximum possible scores in each section and metric are included in Table 1 below.

**Table 1. Metrics for all Sectors**

Metrics	Possible Points
<b>National Efforts</b>	<b>25</b>
Energy Productivity	4
Change in Energy Intensity	4
Efficiency of Thermal Power Plants	4
Mandatory Energy Savings Goals	2
Tax Credits and Loan Programs	3
Energy Efficiency Spending	5
Energy Efficiency Research and Development Spending	3
<b>Buildings</b>	<b>28</b>
Energy Use In Residential Buildings	5
Energy Use in Commercial Buildings	5

<sup>1</sup> Any single metric is affected by multiple factors, in addition to efficiency, that impact a result. For example, certain industrial processes consume more energy per dollar of gross domestic product (GDP) than others. Measuring the amount of energy consumed by a nation against its gross domestic product does indicate something about how efficiently that energy is used, but it doesn't account for other differences such as the overall structure of the economy. A decomposition analysis attempting to separate out some of these effects is possible, but was beyond the scope of our analysis. The International Energy Agency has recently conducted such an analysis in its *IEA Scoreboard 2011* report (IEA 2011b).

Residential Building Codes	3
Commercial Building Codes	3
Building Labeling	3
Appliance and Equipment Standards	6
Appliance and Equipment Labeling	3
<b>Industry</b>	<b>24</b>
Energy Intensity of the Industrial Sector	8
Industrial Electricity Generated by Combined Heat and Power	6
Investment in Manufacturing Research and Development	3
Voluntary Energy Performance Agreements with Manufacturers	3
Mandate for Plant Energy Managers	2
Mandatory Energy Audits	2
<b>Transportation</b>	<b>23</b>
Vehicle Miles Traveled per Capita	3
Passenger Vehicle Fuel Economy	3
Fuel Economy Standards	3
Energy Intensity of Freight Transport	4
Freight Transport per Unit Economic Activity	3
Use of Public Transit	4
Investment in Rail Transit	3

The 12 economies analyzed in the *2012 International Scorecard* analysis make up the “baseline” against which data input into the *Self-Scoring Tool* is scored. Full and partial point values are awarded for each metric according to the actual baseline results from the original analysis. For example, of the 12 economies analyzed the United Kingdom had the highest percentage of industrial electricity generated from combined heat and power applications, or CHP (27%). Results for other economies ranged from 0.1-18% . Based on these results, a maximum score of 6 points can be earned and was awarded for results of 25% or greater. A partial score of 5 points is awarded for results of at least 20%, 4 points are awarded for at least 15% and so on. One point can be earned for at least 2.5% of industrial electricity from CHP. Most countries scored in the middle (3 points) and only one economy scored no points in this category. This process established the baseline scoring which is used to evaluate and score results input into the *Self-Scoring Tool*.

## Getting Started

The *Self-Scoring Tool* is an Excel-based tool and can be downloaded at <http://aceee.org/portal/national-policy/international-scorecard>. Users begin by selecting the tab labeled “National.” Users then follow the instructions to enter the requested inputs. This process should be followed for each of the sheets labeled “Buildings,” “Industry,” and “Transportation.” More detailed descriptions of the data used in each metric are included in this document. Scores for each metric will display below the entry in each sheet. The totals for each section are displayed at the bottom of each respective sheet. The overall score and the scores for each section will display automatically in the sheet labeled “RESULTS.” The “RESULTS” sheet also includes scores for the 12 economies in our *2012 International Scorecard* for comparison.

In the original analysis, we attempted to use internationally recognized, uniform data sources for all countries whenever possible. The *Self-Scoring Tool* provides links and/or information about these resources so that users can enter comparable input values. These resources are from global organizations such as the International Energy Agency (IEA), Organisation for Economic Co-operation and Development (OECD), European Commission, World Bank, and others. However, additional country-focused research is needed to compile some of the data.

The remainder of this document provides additional detail about each of the individual metrics used in the *Self-Scoring Tool*.

## ***National Efforts***

The National Efforts section is intended to convey energy efficiency performance across all sectors of the economy as well as overall commitment and leadership of the national government. These metrics look at the performance of the electricity-generating fleet, the useful productivity of energy consumed, and the change in a nation's energy intensity over time. Metrics in this section examine national commitment by evaluating financial investment in energy efficiency overall and in research and development in emerging technologies. The metrics also evaluate policy indicators such as the presence of national energy savings goals and programs to engage the private sector using tax credits and loans.

### **Energy Productivity (4 possible points)**

We measured energy productivity by taking 2010 gross domestic product in U.S. dollars and dividing it by total energy consumption of primary energy measured in tonnes of oil equivalent (TOE) for the most recent year available (2009) (World Bank 2011; IEA 2011a). This is a measure of the amount of economic output in a country per unit of energy consumed—i.e., higher levels indicate greater efficiency. The full 4 points are awarded to countries with greater than \$16,000 per TOE, 3 points for greater than \$13,000 per TOE, 2 points for greater than \$10,000 per TOE, and 1 point for greater than \$7,000 per TOE.

### **Change in Energy Intensity (4 possible points)**

Energy intensity is the inverse of energy productivity, and equals the amount of energy consumed divided by national gross domestic product (GDP). With this metric we examine change over time, from 2000 to 2009. GDP is adjusted to account for inflation over time, which significantly impacts the outcome. For example, in Russia, GDP has grown substantially over the last decade while energy consumption has remained relatively flat; however, inflation in Russia over this same period has been so high that Russia's energy intensity over time shows no change. Countries with a decline in energy intensity of at least 40% are awarded 4 points, at least a 30% decline receive 3 points, at least a 20% decline receive 2 points, and at least a 10% decline received 1 point.

### **Efficiency of Thermal Power Plants (4 possible points)**

This metric is based on the overall efficiency of the electric power system, accounting for both operational efficiency at power plants and losses that occur during the distribution of electricity. These data indicate how effectively or ineffectively the electric power sector converts fossil fuels into useable electricity. Full points are awarded for overall efficiency of at least 37%, and points were subtracted in increments of 4%. Countries with less than 25% overall thermal efficiency receive no points.

### **Mandatory Energy Savings Goals (2 possible points)**

This metric is scored according to whether a country has a policy outlining a mandatory national energy savings goal. National energy savings goals can send a message across all sectors of an economy, spur innovation, and articulate national priorities. Progress towards a goal is measured, making energy efficiency more tangible and yielding quantifiable results. Full credit is awarded for policies that require a fixed amount of energy savings per year.

### **Tax Credits and Loan Programs (3 possible points)**

This metric reflects a government's policies that encourage private investment in energy efficiency. Energy efficiency investments often pay for themselves over time, but a common barrier to these investments is the upfront cost of the technology or upgrade. Government loan programs and tax credits can help to lower or spread out the upfront costs, thus enabling projects to move forward within the "payback" demands of the entity financing the improvement. In addition, government-backed loan programs and credits can make market conditions for energy efficiency more favorable, attracting additional private investment. The full 3 points are awarded for countries with *both* multi-sector loan programs and multi-sector tax credits. Two points were awarded for countries having one or the other. A country could earn 1 point if it had either tax credits or a loan program for a single sector.

### **Energy Efficiency Spending and Energy Efficiency Research and Development Spending (5 possible points/3 possible points)**

The metric measuring energy efficiency spending is scored based on total investments in energy efficiency by the national government and the utility sector. In some countries the utility sector is controlled by the national government, whereas in countries such as the United States the utility sector is primarily regulated by states. Therefore, to obtain parity among countries, we combined spending by utilities and national governments for each country. We divided the total annual investment (measured in U.S. dollars) by population. The awarding of points is as follows: 5 points are awarded for per capita spending of at least \$200, 4 points for spending of at least \$150 per person, 3 points for at least \$100, 2 points for at least \$50, and 1 point for at least \$20.

To complement this metric, we include a more narrowly defined metric measuring annual per-capita investment in energy efficiency research and development (R&D). These data are much more readily available, and results

are in a tighter range. Three points are awarded for spending exceeding \$4.00 per person, partial credit of 2 points is awarded to countries with spending between \$3.00 and \$4.00 per person, and 1 point is awarded to countries with spending between \$2.00 and \$3.00 per person.

### ***Buildings***

In the Buildings section countries could earn up to 28 points across 7 different metrics. This section quantifies and compares energy use in residential and commercial buildings as well as related policies, such as building energy codes and programs that require disclosure of building energy consumption. This section also scores policy treatment of appliances and equipment, looking at whether performance standards are in place and whether energy consumption of products is disclosed.

#### **Energy Use in Residential and Commercial Buildings (5 possible points each)**

These two metrics are calculated using the most recent data available for total energy consumption divided by the floor space of the building stock. To normalize these results, we factored in differences in seasonal temperatures. We included calculations of the average of the total heating and cooling degree days (the “H&C factor”) in the three most populated cities in a country, and divided energy consumption over floor area by the H&C factor for that country. The results are affected by a number of variables related to building use, including efficiency of buildings, size of buildings, and how heavily buildings are heated and cooled.

#### **Residential and Commercial Building Codes (3 possible points each)**

Scores for these metrics are based on the presence of national, mandatory building codes covering five major areas:

- *Insulation in Walls and Ceiling.* Insulating the “envelope” or “shell” of a house or commercial building includes adding insulation to prevent heat loss in the winter and heat gain in the summer.
- *Window U-Factor and Shading/Solar Heat Gain Coefficient.* The U-factor measures the rate of heat transfer through a window and rates how well the window insulates. The Solar Heat Gain Coefficient (SHGC) measures the fraction of solar energy transmitted and indicates how well the window blocks heat caused by sunlight.
- *Lighting Efficiency Requirements.* Minimum standards for high efficiency lighting and lamps and/or lighting controls are included in some building codes.
- *Heating and Cooling Requirements.* Heating and cooling requirements refer to the efficiency of a building’s heating, ventilating, and air conditioning (HVAC) systems.
- *Air Sealing.* Sealing the “envelope” or “shell” includes getting rid of air leaks throughout a home, such as around windows and doors, and holes in attics, basements, and crawlspaces. These leaks can be sealed using caulk, spray foam, weather stripping, and other sealants (*residential buildings only*).

Countries with mandatory requirements addressing all five of the major elements in the residential sectors receive 3 points. Countries with mandatory requirements in four of the elements score 2 points and countries with requirements in three of the major elements receive 1 point. In the commercial sector, countries with mandatory requirements addressing all four of the major elements receive 3 points. Countries with three elements receive 2 points and countries with two elements receive 1 point. We did not evaluate the effectiveness, stringency, or enforcement of requirements in each country, as finding a consistent way to compare and contrast these variables across the different countries would be particularly challenging and worthy of a report of its own. But we recognize that these are very important aspects of effective building codes, and we will seek to account for some of these additional variables in future editions of this tool.

#### **Labelling and Disclosure of Building Energy Efficiency (3 possible points)**

Scores for the next buildings-related metric are based on the presence of mandatory labeling (or rating) and mandatory disclosure of energy use. A building label creates transparency regarding the energy costs associated with a building, similar to the transparency provided by a miles-per-gallon rating for a vehicle. Disclosure of a building’s energy use can assist in recognizing the value of energy efficiency benefits at the time of a purchase or lease. The full 3 points are given to countries with disclosure and labeling requirements applicable to all buildings (new and existing, commercial and residential). National policies that apply to new buildings and are triggered for existing buildings upon a sale, lease, or remodel are awarded full credit. National policies that apply only to new buildings or only to a subset of buildings (commercial but not residential) are awarded 2 points, and voluntary national policies are awarded 1 point.

### **Appliance and Equipment Standards (6 possible points)**

Policies implementing minimum energy performance standards for appliances and equipment are eligible for up to 6 points. Points are awarded based on the number of appliances and types of equipment covered by standards. This metric does not measure stringency of standards, percentage of energy consumption covered by standards, or compliance with standards, all of which are important factors impacting the energy efficiency of appliances and equipment. Table 2 shows the scoring for this metric.

**Table 2. Scoring of Appliance and Equipment Standards**

Points Awarded	Number of Appliance and Equipment Standards
6	40 or more
5	At least 33
4	At least 26
3	At least 19
2	At least 12
1	At least 5

### **Labelling of Appliance and Equipment Energy Efficiency (3 possible points)**

Labelling programs disclose to consumers information about how much energy an appliance or piece of equipment uses compared to similar products of the same type. The labels typically display the comparative information using a categorical rating or a continuous scale. Categorical labels divide the models into distinct groups based on energy use or efficiency, whereas continuous scales mark the high and low end of energy use or efficiency among models, and place each model in the appropriate place along the continuum. The full 3 points are awarded for categorical labelling requirements that apply to ten or more products. Categorical labelling requirements applying to fewer than ten products are awarded 2 points and continuous labelling requirements are awarded 1 point.

### **Industry**

In the Industrial section of this tool, countries are scored based on the energy intensity of the industrial sector as well as how much of the sector's electricity comes from combined heat and power. Investment in industrial research and development is also scored. The policy metrics evaluated look to government efforts to encourage energy efficiency in the industrial sector through incentives and the implementation of voluntary programs to set energy savings targets, as well as mandates for requiring periodic energy audits and on-site energy managers.

### **Energy Intensity of Industrial Sector (8 possible points)**

This metric is a measure of the total final consumption of energy in the industrial sector (measured in British thermal units or Btu) divided by industrial GDP in U.S. dollars. Countries with the lowest energy consumption per dollar of output (Btu/\$) in the industrial sector are awarded 8 points, with a cutoff of 2.10 Btu per dollar. Points are subtracted for each additional whole Btu per dollar, and countries exceeding 9.10 Btu per dollar received 0 points.

### **Industrial Electricity Generated by Combined Heat and Power (6 possible points)**

Combined heat and power systems generate useful thermal energy and electricity or mechanical power in a single, integrated system. CHP systems are much more efficient than the separate generation of thermal energy and electricity because heat that is normally wasted in conventional power generation is recovered to meet existing thermal demands. Scores are awarded according to the percentage of electricity consumed by the industrial sector that is produced by CHP. A maximum score of 6 points can be earned for results of 25% or greater, 5 points are awarded for results of at least 20%, 4 points are awarded for at least 15%, and so on. One point can be earned for at least 2.5% of industrial electricity from CHP.

### **Investment in Manufacturing Research and Development (3 possible points)**

While manufacturing R&D spending is not exclusively invested in energy efficiency, reducing waste and energy costs improves competitiveness, making energy efficiency a major focus of R&D investments in this sector. Spending included in this metric represents R&D activities carried out in the business enterprise sector, regardless of the origin of funding. We divide total R&D spending in the manufacturing sector by GDP and report the result in U.S. dollars. Up to 3 points are awarded for countries with spending equal to at least 2.25% of GDP. Countries with spending equal to at least 1% of GDP received 2 points and countries with at least 0.50% received 1 point.

### **Voluntary Energy Performance Agreements between National Governments and Manufacturers (3 possible points)**

The scoring for this metric is based on the presence of a national government program for entering into voluntary agreements with businesses in the manufacturing sector to improve energy efficiency. The highest score is awarded for a program that both impacts a diversity of manufacturers and offers incentives for achievements

and/or participation. Countries with agreements that offer incentives *or* are available to a diversity of manufacturers are awarded 2 points.

**Mandate for Plant Energy Managers (2 possible points)**

Two points are awarded for a national law or regulation requiring industrial facilities to employ an energy management expert on site. A dedicated, on-site energy manager can improve processes, identify waste, and maximize the efficient use of energy resources.

**Mandatory Energy Audits (2 possible points)**

Periodic energy audits can help businesses identify opportunities to improve energy efficiency, benchmark improvements, and identify negative trends. Countries are awarded 2 points if there is a national law or regulation requiring periodic energy audits of industrial facilities.

***Transportation***

In the Transportation section, seven metrics are evaluated in the areas of passenger vehicles, public transit, and freight transport. The energy efficiency of passenger vehicles is evaluated using a comparison of fuel economy standards, the average fuel economy of on-road passenger vehicles, and the total vehicle miles traveled per person in a year. The metrics evaluating public transit look at both investment in and use of modes of public transport in a nation. Energy intensity of freight transport is evaluated based on the energy consumed per ton-mile. An additional measure of the efficiency of goods movement is provided by ton-mile per unit GDP, a measure of locational efficiency.

**Vehicle Miles Travelled (3 possible points)**

This metric is scored according to total miles traveled in a year by passenger vehicles (VMT) divided by total population. This information provides some general insight into how much the population of a nation is using automobiles, an inefficient mode for personal transport. Countries with an average VMT per capita of no more than 3,000 receive 3 points; no more than 5,000, 2 points; and no more than 7,000, 1 point.

**Average Fuel Economy and Fuel Economy Standards (3 possible points each)**

For purposes of this metric, fuel economy standards can include limitations on the amount of fuel consumed relative to distance traveled as well as emission limits on carbon dioxide (CO<sub>2</sub>). Countries with requirements that effectively exceed 40 miles per gallon (mpg) by 2015 receive a full score of 3 points while countries with requirements above 35 mpg by 2015 received 2 points. Requirements over 30 mpg by 2015 earn 1 point.

In addition to standards, a separate score is awarded for average on-road fuel economy of passenger vehicles. Countries with fuel economies averaging greater than 35 mpg receive a full 3 points, while countries with an average greater than 30 mpg receive a partial score of 2 points, and countries with an average greater than 25 mpg received 1 point.

**Public Transit Use and Investment in Rail Transit (4 possible points/3 possible points)**

Public transit use is measured by looking at the distance traveled by passengers by rail, bus, and coach divided by total distance traveled by passengers across all motorized modes of inland travel (excluding motorcycles). Countries with greater than 50% of travel completed by public transit receive a full score of 4 points, greater than 35% receive 3 points, greater than 20% receive 2 points, and greater than 5% receive 1 point.

Investment in public transit is measured as the ratio of national government investment in rail versus roads. Countries with spending in a ratio of 0.75 or greater of rail to roads receive a full score of 3 points. Spending in a ratio of 0.50 is awarded 2 points, and spending of 0.25 is awarded 1 point. Investment in all transit modes would have been a superior metric, but these data were not readily available.

**Energy Efficiency of Freight Transport and Freight Transport per Unit of Economic Activity (4 possible points/3 possible points)**

To assess the energy intensity of freight transport in a nation we used a metric measuring energy (kBtu) consumed per ton-mile traveled. Countries with lower than 1.4 energy consumed per ton-mile traveled receive a full score of 4 points, lower than 2.1 receive 3 points, lower than 2.8 receive 2 points, and lower than 3.5 receive 1 point.

The amount of freight transport per unit of economic activity, which can be considered a measure of location-efficiency of industrial and commercial activity, is measured by looking at ton-miles per dollar of GDP. Countries with lower than 0.07 ton-miles per dollar of GDP receive a full score of 3 points, lower than 0.24 ton-miles per dollar of GDP receive 2 points, and lower than 0.41 ton-miles per dollar of GDP receive 1 point.

## Conclusion

It is our hope that the *Self-Scoring Tool* will be used to identify energy efficiency progress and opportunities for improvement in countries, states, and other jurisdictions. For countries not included in the *2012 International Scorecard* analysis, this tool provides an opportunity to compare policies and economy-wide energy efficiency with other nations and identify specific areas where other countries are doing better. In addition, countries that have already been analyzed can see how different policy options might affect their scores and improve their rankings. We are always seeking to improve the quality of our data and in 2013 we will begin collecting data for the *2014 ACEEE International Energy Efficiency Scorecard*. With this in mind, we encourage users to send us their results. Results and questions about this document or the *ACEEE International Self-Scoring Tool* should be directed to Sara Hayes at [shayes@aceee.org](mailto:shayes@aceee.org).

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## References

[IEA] International Energy Agency. 2011a. *Data Services* (2011 edition). Paris, France: International Energy Agency.

———. 2011b. *IEA Scoreboard 2011*. <http://www.iea.org/w/bookshop/add.aspx?id=416>. Paris, France: International Energy Agency.

World Bank. 2011. *World Development Indicators: GDP (current US\$)*. World databank edition 2011. Washington DC: The World Bank.