The 2014 International Energy Efficiency Scorecard

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Executive Summary

A country that uses less energy to achieve the same or better results reduces its costs and pollution, creating a stronger, more competitive economy. While energy efficiency has played a role in the economies of developed nations for decades, cost-effective energy efficiency remains a massively underutilized energy resource.

In this second edition of the *International Energy Efficiency Scorecard,* we analyze the world's 16 largest economies covering more than 81% of global gross domestic product and about 71% of global electricity consumption. We looked at 31 metrics divided roughly in half between policies and quantifiable performance to evaluate how efficiently these economies use energy. The policy metrics were scored based on the presence in a country or region of a best-practice policy. Examples of policy metrics include the presence of a national energy savings target, fuel economy standards for vehicles, and energy efficiency standards for appliances. The performance metrics are a measure of energy use and provide quantifiable results. Examples of performance metrics include average miles per gallon of on-road passenger vehicles and energy consumed per square foot of floor space in residential buildings. The metrics are distributed across the three primary sectors responsible for energy consumption in an economically developed country: buildings, industry, and transportation. We have also included a number of metrics that cut across these sectors (such as the efficiency of electricity generation) and that indicate a national commitment to energy efficiency. These metrics are included in a national efforts section. The maximum possible score for a country is 100 points, and we allocated 25 points to each of these four sections, assigning a point value to each metric. We then scored and ranked all economies based on the results of our research.

Germany has the highest overall score, with 65 out of 100 possible points. The top-scoring countries in each category are: China in buildings, Germany in industry, Italy in transportation, and a three-way tie between France, Italy, and the European Union in national efforts.

Our results indicate that some countries are significantly outperforming others, but the more important finding is that there are substantial opportunities for improvement in all economies analyzed. The conditions required for a perfect score are currently achievable and in practice somewhere on the globe. For every metric, at least one country (and often several) received full points. However, every country also has serious weaknesses, and the average score was just 50 points.

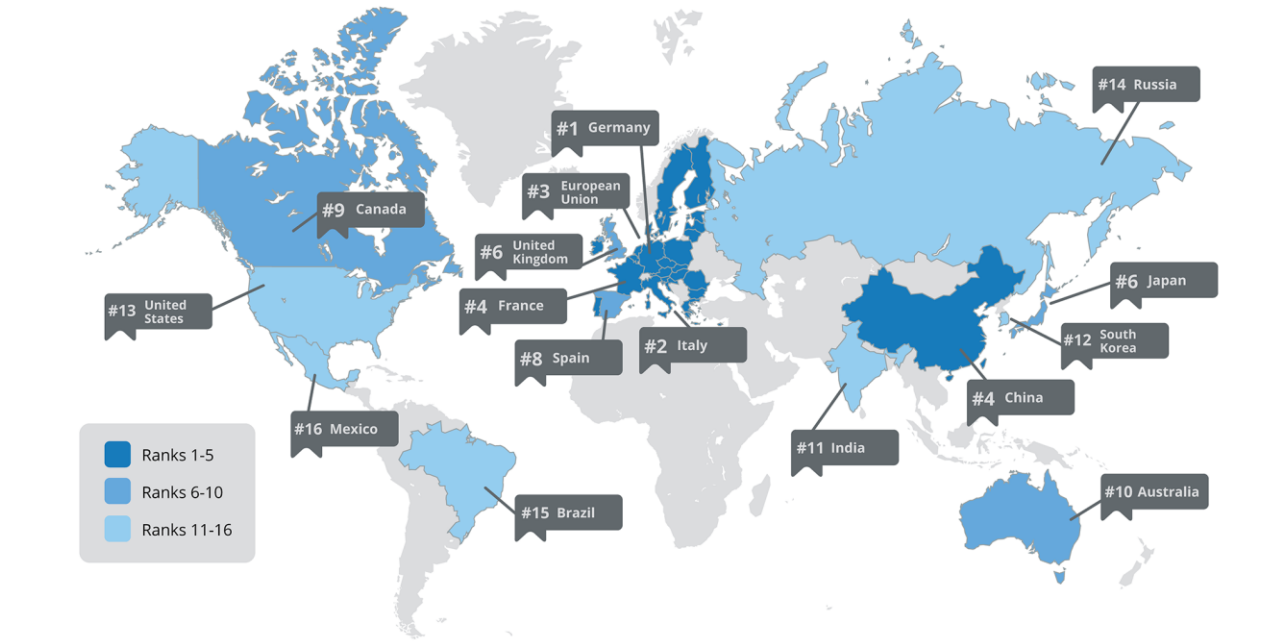
Understanding exactly why countries scored and ranked where they did requires a detailed look at the metrics; however, generally, the top-scoring countries scored solidly across all four sections.

The United States has made some progress toward greater energy efficiency in recent years, particularly in areas such as building codes, appliance standards, voluntary partnerships between government and industry, and, recently, fuel economy standards for passenger vehicles and heavy-duty trucks. However, the overall story is disappointing. The United States, long considered an innovative and competitive world leader, has progressed slowly and has made limited progress since the last *International Scorecard* in 2012. In contrast,

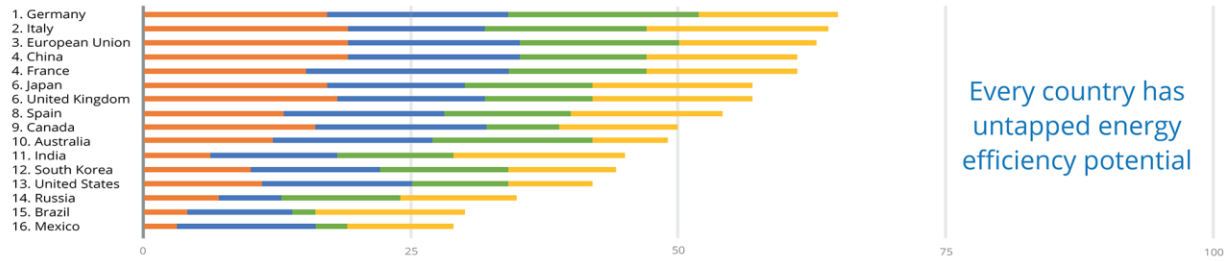
countries including Germany, Japan, and China are surging ahead. Countries that use energy more efficiently use fewer resources to achieve the same goals, thus reducing costs, preserving valuable natural resources, and gaining a competitive edge over other countries. In the United States, a great deal of resources are wasted, and costs have been allowed to remain unnecessarily high.

The inefficiency in the U.S. economy means a tremendous waste of energy resources and money. Across most metrics analyzed in this *International Scorecard*, in the past decade the United States has made limited progress toward greater efficiency at the national level. The overall U.S. score of 42 is less than half of the possible points and is 23 points away from the top spot. Further, the United States falls behind Canada, Australia, India and South Korea. These scores suggest that this list of countries may have an economic advantage over the United States because using less energy to produce and distribute the same economic output costs them less. Their efforts to improve efficiency likely make their economies more nimble and resilient. This raises a critical question: looking forward, how can the United States compete in a global economy if it continues to waste money and energy that other industrialized nations save and can reinvest? This report offers a number of recommendations for the United States. Figure ES-1 shows a high level snap shot of the results of the report and four major opportunities for the United States.

2014 International Energy Efficiency Scorecard



Overall country scores with sector breakdown



THE US RANKS #13 OUT OF 16

The United States – long considered an innovative and competitive world leader – has allowed other nations to surpass it.

What can the U.S. do to improve?

NATIONAL EFFORTS

The U.S. Congress should pass a national energy savings target.

A national energy savings target such as HR 5072 would push a unified effort for efficiency and spur greater investment in energy efficiency.

BUILDINGS

The federal government should strengthen national model building codes.

National model codes should be updated and the federal government should provide technical assistances to states implementing and adopting energy efficiency building codes.

INDUSTRY

The federal government should support education and training in the manufacturing and industrial sectors.

Government should support the manufacturing and industrial sector to reduce the energy intensity of facilities by providing education, outreach and training that will facilitate greater investment in energy efficiency and quicker adoption of systematic energy management practices.

TRANSPORTATION

The U.S. Congress should prioritize energy efficiency in transportation spending.

Government budgets should apply energy efficiency performance metrics in prioritizing federal transportation investments and increase funding levels for energy–efficient modes of passenger and freight transport.

ACEEE
American Council for an Energy-Efficient Economy

Figure ES-1. Rankings for all economies analyzed

In addition, the United States should follow through on efforts that it has already begun. For example, the Environmental Protection Agency has drafted a proposal pursuant to Section 111(d) of the Clean Air Act that could lead to improved efficiency of fossil-fuel power plants and increased investment in energy efficiency. The final rule should ensure that these efficiency improvements are realized. The Agency and the Department of Transportation are also in the process of finalizing fuel economy standards for light-duty vehicles. For light-duty vehicles, standards should be at least as stringent as the current provisional standards, and for heavy-duty vehicles the United States should set standards at 40% or more below 2010 levels.

By taking these steps, the United States would increase its world ranking in energy efficiency significantly. The opportunities for improvement in global competitiveness and economic resiliency in the United States and worldwide are considerable. Countries can preserve their resources, address global warming, stabilize their economies, and reduce the costs of their economic outputs by using energy more efficiently—an eminently achievable goal.

Introduction

A country with high levels of energy efficiency, using less energy to achieve the same or better results, reduces costs and pollution, and supports a stronger, more competitive economy. While energy efficiency has played a major role in the economies of developed nations for decades, cost-effective energy efficiency remains a massively underutilized energy resource worldwide (Laitner et al. 2012).

This report has two primary goals. First, similar to the American Council for an Energy-Efficient Economy's (ACEEE) *State Energy Efficiency Scorecard* (Downs et al. 2013b), this report analyzes a wide range of variables indicative of the overall energy efficiency of economically developed nations. The results of this analysis provide insight into the best policies and practices across nations, and constitute a benchmark that nations can use to improve their energy efficiency.

This report is the second edition of the *International Energy Efficiency Scorecard*; the first was released in 2012. In this edition of the report, we expanded our list of countries to include the world's 16 largest economies (15 countries and the European Union (EU)). These global economies represent more than 81% of global gross domestic product (GDP), 71% of global energy consumption, and 79% of the global carbon-dioxide-equivalent emissions.

This report identifies best practices across 31 key metrics directly related to a country's overall energy efficiency. These metrics span three major economic sectors as well as take a cross-sector snapshot of national commitment to energy efficiency: national efforts, buildings, industry, and transportation. While no single metric can provide a complete picture of a nation's energy efficiency, these metrics together give an indication of overall energy efficiency in a country compared to other countries.

This report is unique in that, in addition to compiling key information specifically related to the energy efficiency of a country, it provides complementary resources and analysis so that comparisons can be made, highlights best practices, and provides benchmarks by which countries' progress toward improving their energy efficiency can be compared. The report includes a list of the best practices that received the highest score within each metric, graphics and discussions of each metric, and short summaries of results for each country.

This *International Scorecard* also offers specific recommendations for how the United States can reduce its energy waste, pollution, and greenhouse gas emissions, and strengthen its global competitiveness into the future.

Methodology

In this second edition of the *International Scorecard*, we evaluated a total of 16 countries (see Table 1). We wanted to focus on a comparison of economically developed nations, because the data from these countries are more closely comparable to those of the United States. We included the largest economies—United States, China, Japan, Germany, France, United Kingdom (UK), Brazil, Russia, Italy, India, Canada, Australia, Spain, Mexico, and South

Korea as well as the EU. It should be noted that while the EU is not a country, as a whole it represents an economy comparable to that of the United States in many ways.[1]

Data for each country were obtained from centralized, internationally recognized sources when available, such as the International Energy Agency, the Organisation for Economic Co-operation and Development, and the World Bank. This information was supplemented with individual-country research by ACEEE staff. We sought the counsel of in-country and subject-matter experts to confirm that we had accessed the best sources of information and to review our findings prior to publication.

Table 1. Gross domestic product and energy consumption by country

	GDP (trillion current $)	Total final consumption (ktoe) (1,000 tonnes of oil equivalent)	Building consumption (ktoe)	Industrial consumption (ktoe)	Transport consumption (ktoe)	Population
Australia	1.53	77,847	17,420	23,120	28,617	22,683,600
Brazil	2.25	217,889	34,114	82,808	69,987	198,656,019
Canada	1.82	203,975	59,246	56,476	59,487	34,880,491
China	8.23	1,634,706	59,246	783,253	174,165	1,350,695,000
EU	16.69	1,143,539	416,453	269,073	316,425	509,036,794
France	2.61	152,203	57,894	28,523	44,272	65,696,689
Germany	3.43	221,023	86,100	54,953	53,050	81,889,839
India	1.84	492,513	196,041	168,068	55,491	1,236,686,732
Italy	2.01	126,749	47,064	28,888	38,508	60,917,978
Japan	5.96	314,473	112,382	84,731	76,947	127,561,489
Mexico	1.18	116,070	21,755	29,186	51,847	120,847,477
Russia	2.01	458,571	153,395	128,113	96,485	143,533,000
South Korea	1.13	161,041	40,302	47,200	29,424	50,004,000
Spain	1.32	88,596	25,741	20,489	32,050	46217961
UK	2.47	126,301	49,869	25,968	41,264	63,227,526
USA	16.24	1,503,707	468,996	287,006	583,443	313,914,040

Sources: IEA 2014 (energy consumption data); World Bank 2013 (GDP and population data).

[1] Many of the metrics we collected were available for the EU as a whole, although in some cases a metric representing the EU is actually based on fewer than the full 27 member nations, which we note when it occurs.

We identified a list of indicators, or metrics, that together reflect the level of energy efficiency across a nation's economy and its commitment to energy efficiency. We then sought the advice of a group of expert advisors and revised the list according to their input. We reviewed the existing literature and research on the topics on the revised list and identified mechanisms by which to measure the indicators. The result was the conversion of the list of indicators into 31 metrics. These metrics are divided roughly in half between policies and quantifiable measures of performance. The policy metrics were evaluated by the presence of best-practice policies, such as a national target for energy savings, fuel economy standards for vehicles, and energy efficiency standards for appliances. The performance metrics measure energy use and provide quantifiable data. Examples of performance metrics include the ratio of energy consumed by a country to its GDP, the average miles per gallon (mpg) of on-road passenger vehicles, and the energy consumed per square foot of floor space in residential buildings. To facilitate comparisons between countries, we normalized many of the results using variables such as population or GDP. A description of this process is included in the discussion below of each metric for which the results were normalized.

The maximum possible score for a country was 100. We allocated 25 points to each sector, and the points available for the metrics within each sector were allocated according to the recommendations of expert advisors (Table 2). The highest score available for a given metric was always awarded to at least one country.

Table 2. Metrics for all sectors

Metrics	Points
National efforts	**25**
Change in energy intensity	6
Efficiency of thermal power plants	3
Mandatory energy-savings goals	3
Tax credits and loan programs	3
Spending on energy efficiency	5
Spending on energy efficiency research and development	2
Size of the energy service companies market*	2
Water efficiency policy*	1
Buildings	**25**
Energy intensity in residential buildings	4
Energy intensity in commercial buildings	4
Residential building codes	3
Commercial building codes	3
Building labeling	2
Appliance and equipment standards	5
Appliance and equipment labeling	2
Building retrofit policies*	2

Industry	**25**
Energy intensity of the industrial sector	8
Electricity generated by combined heat and power	6
Investment in manufacturing research and development	2
Voluntary energy-performance agreements with manufacturers	3
Mandate for plant energy managers	2
Mandatory energy audits	2
Agriculture energy intensity*	2
Transportation	**25**
Vehicle miles traveled per capita	3
Fuel economy of light-duty vehicles	3
Fuel economy standards for light-duty vehicles	4
Fuel efficiency standards for heavy-duty tractor trucks*	3
Energy intensity of freight transport	3
Freight transport per unit economic activity	3
Use of public transit	3
Investment in rail transit vs. roads	3

*Denotes a new metric added since the last edition of this report.

DATA AND ANALYTICAL LIMITATIONS

To collect comparable data across nations is challenging. In some cases, the data were simply not able to be collected. In few cases, we have assigned scores to a country for a particular metric based on a combination of best estimates and data that were available. We have noted this in each instance.

The scoring framework used for this analysis is our best attempt to represent a wide range of factors that measure the energy efficiency of a nation. The results for any single metric are affected by factors other than efficiency per se, and some of these factors involve fixed attributes of a nation (e.g., predominant industries, climate and geography, population) that can boost or weaken its rank relative to other countries for reasons outside of the country's control. Therefore, while there are many complexities and national differences that we cannot adjust for through our scoring methodology, we made adjustments where we could, in an effort to have the rankings reflect levels and types of energy efficiency that were within the control of the countries and thus minimize the non-efficiency causes for differences in data across countries. For example, climate, weather, geography, and population (size as well as density) are variables that impact energy use and that vary across the globe. We have made some adjustments to account for these differences, which are described in the discussion of each metric; however, limitations remain. For example, we measured the change in energy intensity using the amount of energy consumed by a nation against its GDP, which does not take into account the structure of the economy. While this does indicate something about how efficiently that energy is used, it does not account for

other differences such as shifts in overall structure of the economy. Given the limitations that remain, this *Scorecard*'s analysis and rankings should be considered in the context of these non-efficiency-related factors.

Another important and variable factor not assessed in this *Scorecard* are regulations and policies that emanate from regional, state, and city governments. Their relative importance varies across nations, and they can be just as effective as national regulations and policies, but, with few exceptions, local efforts are beyond the scope of this report.

To facilitate comparisons among countries, we have normalized many of the results using variables such as population and GDP, among others, and we want to call attention to the effect that this has on some countries' rankings. Table 3 and Table 4 show the difference in results when national energy consumption is compared with either population or GDP. In both tables the countries are ranked starting with the least energy consumed, but the choice of normalizing variable changes the ranking order. Some of the largest differences can be seen in the difference between where India and China fall, from lowest energy per capita to highest energy consumption per unit GDP (see differences between Table 4 and Table 5 below). By contrast, many of the European countries hardly move; Spain is ranked sixth in both tables. We consulted expert advisors in an attempt to choose the most appropriate normalizing variable(s) for each metric.

Table 3. Total final energy consumption per capit

	Tonne of oil equivalent per person
India	0.6
Brazil	1.4
Mexico	1.6
China	2.0
Italy	2.6
Spain	2.7
UK	3.0
EU	3.3
Japan	3.5
France	3.8
Germany	3.8
Russia	5.1
South Korea	5.3
Australia	5.9
USA	6.8
Canada	7.2

Table 4. Total final energy consumption per dollar of GDP

	Tonne of oil equivalent per billion dollars
Japan	75.8
UK	77.8
Italy	78.7
Australia	87.2
Germany	89.7
Spain	94.2
France	96.3
EU	99.6
Brazil	119.9
USA	131.3
Canada	138.7
Mexico	162.9
South Korea	232.8
China	331.6
Russia	362.8
India	406.9

Sources: IEA 2014 (energy consumption data); World Bank 2013 (GDP and population data).

CHANGES SINCE THE 2012 SCORECARD

Since the *2012 International Scorecard* we have improved several metrics through more consistent and centralized data sources, through more input from in-country experts, and by making adjustments to some metrics. We have also added some new metrics and adjusted some of the scoring criteria. The new metrics evaluate water efficiency, agricultural efficiency, building retrofit policies, heavy-duty fuel economy standards, investment in energy efficiency by the private sector. An explanation of each metric is given in the relevant section in the body of the report.

In the *2012 Scorecard* we looked at both energy productivity and change in energy intensity over time. For this edition we eliminated the energy productivity metric, since energy productivity is part of each of the national sector analyses, and we did not want to double count these efforts. We also reallocated some of the points, dividing the 100 points evenly across the four categories and shifting some points to the new metrics.

Lastly, we have improved the precision of some of our existing metrics based on feedback from international experts and more powerful data collection techniques. For example, the

industrial energy intensity metric is now weighted to reflect structural differences in economies. Our approach to each metric is discussed in the relevant sections below.

Results

Figure 1 shows the final ranking for each country, Table 6 lists the scores by country for each metric, and Table 7 provides the section totals and lists the countries in order of rank for each section.

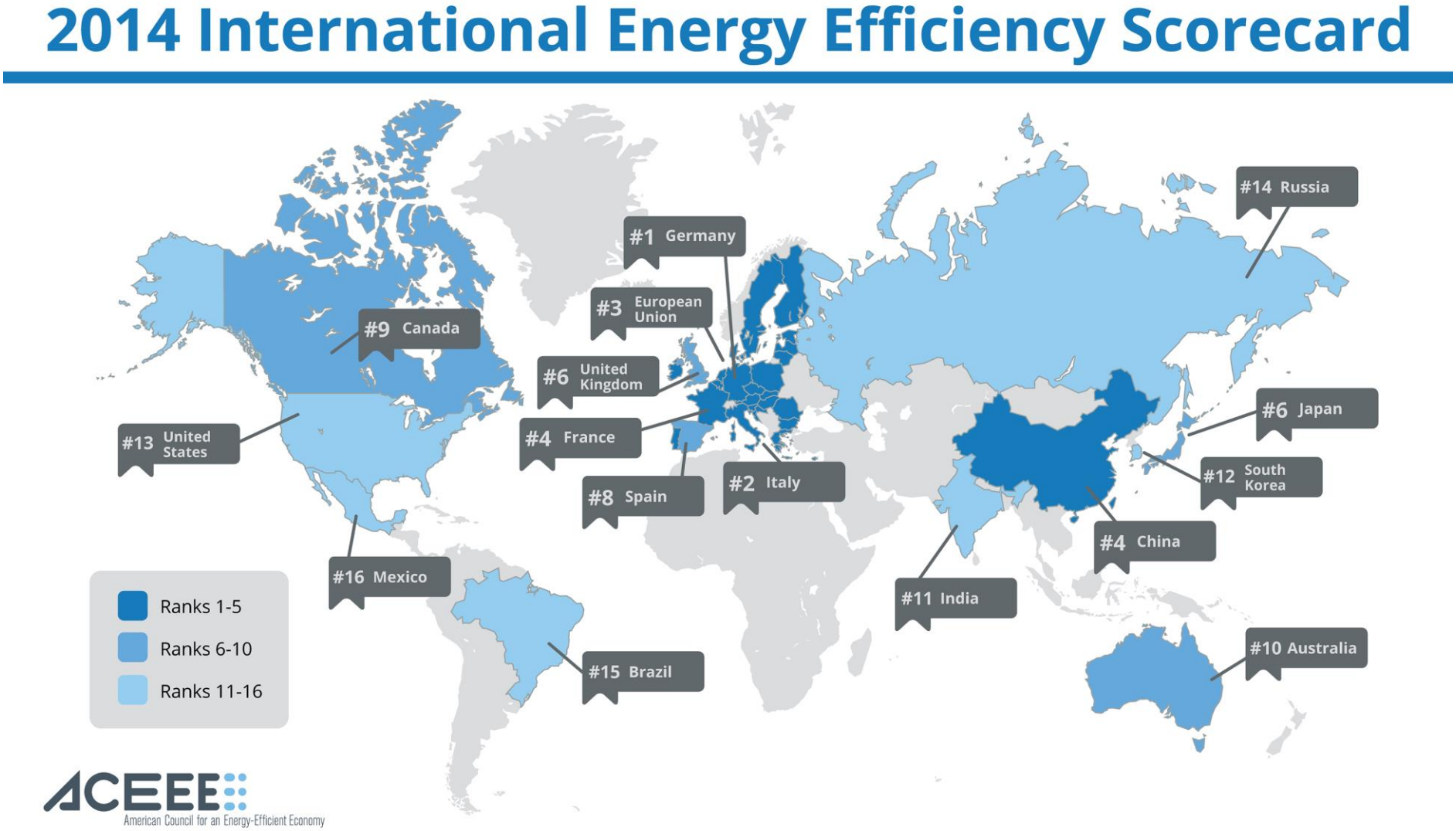


Figure 1. Rankings for all economies analyzed

Table 5. Scores for all metrics by country

Metrics	Total	Australia	Brazil	Canada	China	E.U.	France	Germany	India	Italy	Japan	Mexico	Russia	South Korea	Spain	U.K.	U.S.
National efforts total	**25**	**12**	**4**	**17**	**15**	**19**	**19**	**17**	**6**	**19**	**17**	**3**	**7**	**10**	**13**	**18**	**11**
Change in energy intensity	**6**	5	0	4	5	4	6	5	1	4	4	0	0	0	4	3	1
Efficiency of thermal power plants	**3**	1	0	2	1	2	0	2	0	2	3	1	0	2	2	2	2
Mandatory energy savings goals	**3**	1	1	1	2	2	3	3	2	2	2	0	2	2	3	3	0
Tax credits and loan programs	**3**	1	2	3	2	3	3	3	2	3	3	2	3	3	2	2	3
Spending on energy efficiency	**5**	1	0	3	2	3	2	3	0	5	2	0	2	0	1	4	3
Spending on energy efficiency research and development	**2**	2	0	2	0	2	2	1	0	1	2	0	0	1	0	2	1
Size of the energy service companies	**2**	0	0	1	2	2	2	0	0	1	0	0	0	1	0	1	1
Water efficiency policy	**1**	1	1	1	1	1	1	0	1	1	1	0	0	1	1	1	0
Buildings total	**25**	**15**	**10**	**15**	**19**	**16**	**16**	**17**	**12**	**13**	**13**	**13**	**6**	**12**	**15**	**14**	**14**
Energy intensity in residential buildings	**4**	2	4	2	4	1	1	1	3	1	2	4	0	0	2	0	2
Energy intensity in commercial buildings	**4**	0	3	2	4	2	1	2	4	0	0	4	1	1	0	2	1
Residential building codes	**3**	3	0	2	2	3	3	3	0	3	2	0	1	3	3	3	2
Commercial building codes	**3**	3	0	2	2	3	3	3	2	2	3	1	1	3	3	3	2
Building labeling	**2**	2	0	0	1	2	2	2	0	2	1	0	1	0	2	2	0
Appliance and equipment standards	**5**	2	1	5	4	2	2	2	0	2	2	3	0	3	2	2	5
Appliance and equipment labeling	**2**	2	2	1	2	2	2	2	2	2	2	1	1	2	2	2	1
Building retrofit policies	**2**	1	0	1	0	1	2	2	1	1	1	0	1	0	1	0	1
Industry total	**25**	**15**	**2**	**7**	**13**	**15**	**12**	**18**	**11**	**15**	**12**	**3**	**11**	**12**	**12**	**10**	**9**
Energy intensity of the industrial sector	**8**	8	1	3	0	4	4	6	0*	3	2	1	0	1	4	2	3
Electricity generated by combined heat and power	**6**	1	0	0	5	5	1	4	1	6	1	1	5	3	2	2	2
Investment in manufacturing research and development	**2**	1	1	1	0	0	1	1	2	0	2	0	0	2	0	2	2
Voluntary energy-performance agreements	**3**	3	0	3	2	3	3	3	2	3	2	0	3	3	2	3	2
Mandate for plant energy managers	**2**	0	0	0	2	0	0	0	2	2	2	0	0	0	0	0	0
Mandatory energy audits	**2**	2	0	0	2	2	2	2	2	0	2	0	2	2	2	0	0
Agriculture energy intensity	**2**	0	0	0	2	1	1	2	2	1	1	1	1	1	2	1	0
Transportation total	**25**	**7**	**14**	**11**	**14**	**13**	**14**	**13**	**16**	**17**	**15**	**10**	**11**	**10**	**14**	**15**	**8**
Vehicle miles traveled per capita	**3**	1	2	1	3	1	2	1	3	2	1	2	2	1	2	1	0
Fuel economy of light-duty vehicles	**3**	0	2	1	1	2	2	2	3	3	2	1	1	1	2	3	0
Fuel economy standards for light-duty vehicles	**4**	0	1	2	1	4	4	4	2	4	3	1	0	1	4	4	2
Fuel efficiency standards for heavy-duty tractor trucks	**3**	0	0	3	2	0	0	0	0	0	1	0	0	0	0	0	3
Energy intensity of freight transport	**3**	3	2	2	2	1	1	2	2	1	1	0	3	0	1	1	2
Freight transport per unit economic activity	**3**	1	1	2	0	2	3	2	1	3	3	2	0	2	2	3	1
Use of public transit	**3**	1	3	0	3	1	1	1	3	1	3	3	2	3	1	1	0
Investment in rail transit vs. roads	**3**	1	3	0	2	2	1	1	2	3	1	1	3	2	2	2	0
Total	**100**	**49**	**30**	**50**	**61**	**63**	**61**	**65**	**45**	**64**	**57**	**29**	**35**	**44**	**54**	**57**	**42**

*Score based on ACEEE estimate

Table 6. Final scores and ranking by country

Total (100 points)		
	Score	Rank
Germany	65	1
Italy	64	2
EU	63	3
China	61	4
France	61	4
Japan	57	6
UK	57	6
Spain	54	8
Canada	50	9
Australia	49	10
India	45	11
South Korea	44	12
USA	42	13
Russia	35	14
Brazil	30	15
Mexico	29	16

National efforts (25 points)		
	Score	Rank
EU	19	1
France	19	1
Italy	19	1
UK	18	4
Germany	17	5
Japan	17	5
Canada	17	5
China	15	8
Spain	13	9
Australia	12	10
USA	11	11
South Korea	10	12
Russia	7	13
India	6	14
Brazil	4	15
Mexico	3	16

Buildings (25 points)		
	Score	Rank
China	19	1
Germany	17	2
EU	16	3
France	16	3
Australia	15	5
Canada	15	5
Spain	15	5
USA	14	8
UK	14	8
Italy	13	10
Japan	13	10
Mexico	13	10
India	12	13
South Korea	12	13
Brazil	10	15
Russia	6	16

Industry (25 points)		
	Score	Rank
Germany	18	1
Italy	15	2
Australia	15	2
EU	15	2
China	13	5
France	12	6
Japan	12	6
Spain	12	6
South Korea	12	6
India	11	10
Russia	11	10
UK	10	12
USA	9	13
Canada	7	14
Brazil	2	15
Mexico	3	16

Transportation (25 points)		
	Score	Rank
Italy	17	1
India	16	2
Japan	15	3
UK	15	3
Brazil	14	5
China	14	5
France	14	5
Spain	14	5
EU	13	9
Germany	13	9
Canada	11	11
Russia	11	11
Mexico	10	13
South Korea	10	13
USA	8	15
Australia	7	16

Figure 2 and Figure 3 show the results compounded by sector for each country, illustrating the large overall difference between the top-ranking and lowest-ranking countries. It also makes evident that there is substantial room for improvement across all countries. We awarded a top score in each metric—this means that if any country emulates the top practices and results in each metric, it can obtain a score of 100.

Figure 2. Country scores by sector

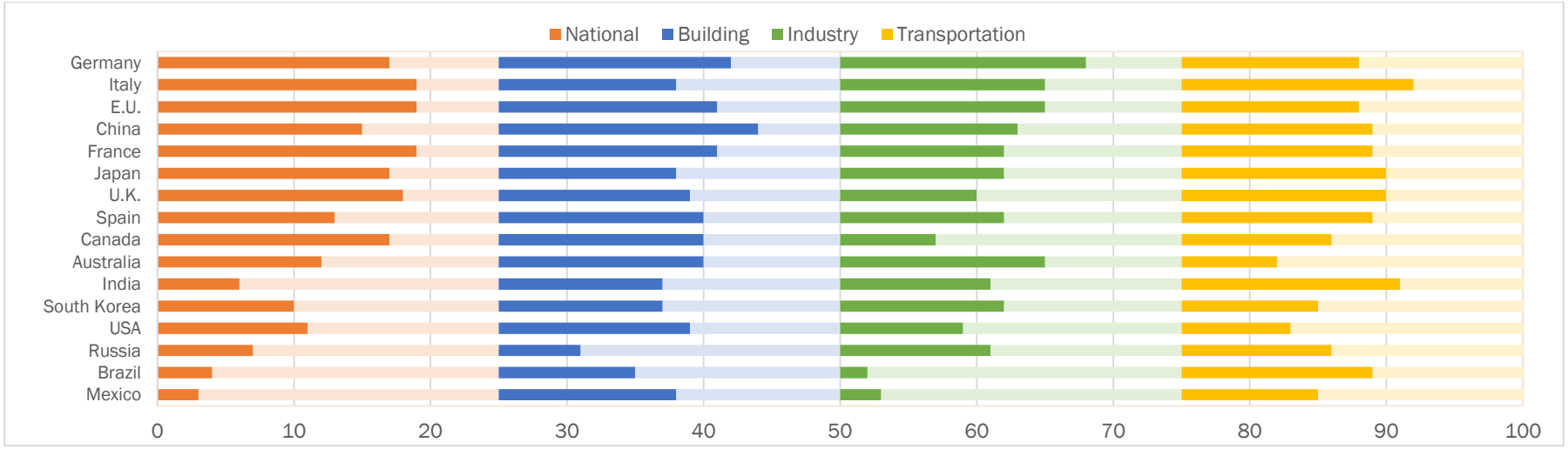
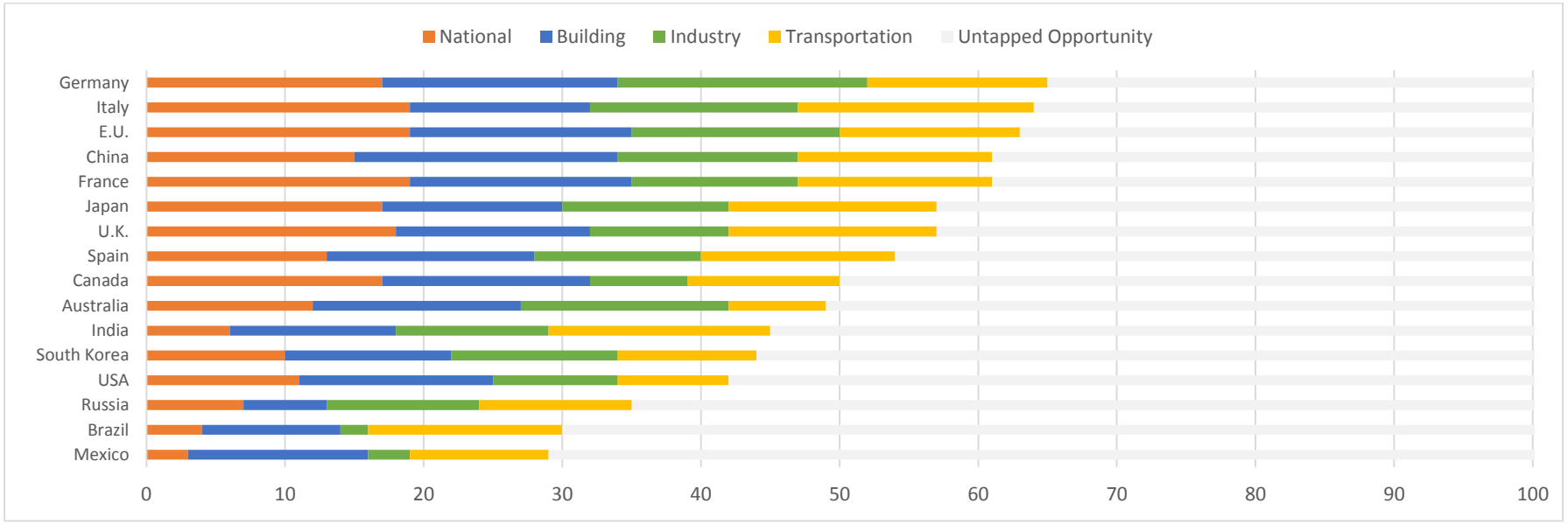


Figure 3. Overall country scores with sector breakdown



While sector scores are informative, a look at countries' overall policies and performance is also revealing. Specifically, when countries are ranked according to the policy-related metrics, we see different leaders emerging such as Japan and the European countries. Table 7 shows the breakdown of points in policy-related metrics. Table 8 shows the rankings out of the 50 possible points. France scored 36 points, and the UK, Germany and the EU all scored 35. At the bottom is Mexico scoring 9 points, preceded by Brazil with 12 points.

Table 7. Point allocation for policy metrics

Section	Policy metrics	Points
National efforts	Mandatory energy-savings goals	3
	Tax credits and loan programs	3
	Spending on energy efficiency	5
	Spending on energy efficiency research and development	2
	Water efficiency policy	1
Buildings	Residential building codes	3
	Commercial building codes	3
	Building labeling	2
	Appliance and equipment standards	5
	Appliance and equipment labeling	2
	Building retrofit policies	2
Industry	Investment in manufacturing research and development	2
	Voluntary energy-performance agreements with manufacturers	3
	Mandate for plant energy managers	2
	Mandatory energy audits	2
Transportation	Fuel economy standards for light-duty vehicles	4
	Fuel efficiency standards for heavy-duty tractor trucks	3
	Investment in rail transit vs. roads	3
Total		**50**

Table 8. Countries ranked by total score for policy metrics (50 possible points)

	Points	Rank
France	36	1
UK	35	2
Germany	35	2
EU	35	2
Japan	34	5

	Points	Rank
Italy	34	5
Canada	30	7
Spain	30	7
China	29	9
South Korea	28	10
USA	27	11
Australia	27	11
India	22	13
Russia	20	14
Brazil	12	15
Mexico	9	16

Table 9 shows the breakdown of points allocated to performance metrics, and Table 10 shows the country scores. Out of 50 possible points, China scored 32 points, and Germany scored 30 points. Russia and the United States scored the least points (15 points), led by South Korea (16 points).

Table 9. Point allocation for performance metrics

Section	Performance metrics	Points
National efforts	Change in energy intensity	6
	Efficiency of thermal power plants	3
	Size of the energy service companies market	2
Buildings	Energy intensity in residential buildings	4
	Energy intensity in commercial buildings	4
Industry	Energy intensity of the industrial sector	8
	Electricity generated by combined heat and power	6
	Agriculture energy intensity	2
Transportation	Vehicle miles traveled per capita	3
	Fuel economy of light-duty vehicles	3
	Energy intensity of freight transport	3
	Freight transport per unit economic activity	3
	Use of public transit	3
Total		**50**

Table 10. Countries ranked by total score for performance metrics (50 possible points)

	Points	Rank
China	32	1
Germany	30	2
Italy	28	3
EU	28	3
France	25	5
Spain	24	6
India	23	7
Australia	23	7
Japan	23	7
UK	22	10
Canada	20	11
Mexico	20	11
Brazil	18	13
South Korea	16	14
USA	15	15
Russia	15	15

As seen in Table 8 and Table 10, countries that performed well in the policy metrics did not necessarily rank high in the performance metrics. This implies that even though certain countries are leading the way on energy efficiency policy, they may not necessarily be achieving the lowest energy intensity, and vice versa. For example, China was the highest-scoring country in the performance metrics, but it ranked 9th in the policy metrics. In contrast, France was the highest performing in the policy metrics but scored 5th in the performance metrics. This illustrates why we have included both policy and performance indicators in order to create a rounded picture of what countries can do to enhance their energy efficiency while still accounting for actual energy intensity reductions.

TRENDS

The *International Scorecard* is only beginning to be able to identify trends, having been first published in 2012. While at first glance there appear to be many differences in the scores of some countries, and therefore trends, most of those differences can be explained by our addition of five new metrics and/or scoring adjustments (see the discussion of additions and adjustments in the Methodology section). For example, while China's score increased by 6 points since the 2012 edition, the 6 points earned were from new metrics rather than from an improvement in its policies or performance in existing metrics. Given that there were many changes to metrics and scoring, we have not included a detailed comparison of the countries and their scores from the *2012 International Scorecard* and this edition of the report.

Although a side-by-side comparison of past and current results does not prove particularly illuminating because of the still-narrow time frame, some trends can be identified. The most dramatic trend is the stagnation that many countries are experiencing. While there are some areas in which some countries have made progress; overall, countries are failing to adopt best practices, and if they improve, they do so in small increments. The story of stagnation and inaction applies to the United States in particular. The United States remained in the bottom third of the countries analyzed, and while it adopted fuel efficiency standards for heavy-duty vehicles, the amount of combined heat and power (CHP) supplying electricity in the country declined. In addition, most of the best practices adopted in other nations have still not been adopted here.

Data in several countries indicate that, in some cases, efficiency investments and policies have been rolled back, and performance has declined. One country in which a clear backward trend exists is Australia. The country has dramatically reduced its investment in efficiency and has rolled back its efficiency incentive programs, causing its score to decline. Similarly, the UK has increased the interest rates on its efficiency loans and has limited its incentives for energy-efficient technologies.

National Efforts

The national efforts section conveys energy efficiency performance across all sectors of the economy as well as the overall commitment and leadership of the national governments. These metrics look at the performance of the electricity-generating fleet and the change in nations' energy intensity over time. Metrics in this section examine national commitment by evaluating financial investment in energy efficiency overall and in research and development (R&D) in emerging technologies specifically. 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.

Out of 25 possible points (see Table 11), the highest-scoring economies across the national efforts metrics are the EU, France, and Italy with 19 points. The EU stood out for having energy efficiency policies across the board. Japan tied for fifth but continues to have the highest efficiency of electricity production from thermal power plants out of all of the countries in our study, and it scored well due to energy efficiency spending, tax credits, and loan programs, as well as investment in R&D. The United States scored in the middle of the pack with 11 points, just above South Korea and below China and Spain. The United States is lacking national policies that set energy and water efficiency goals. The lowest-scoring countries included Mexico and Brazil, both of which lacked energy savings goals and had low levels of investment in energy efficiency programs and R&D.

Most countries had national energy savings goals of at least 1% savings per year on average as well as programs to encourage private investment in energy efficiency, such as loans and tax credits. National investment in energy efficiency varied widely across countries, but in some cases increased as part of a greenhouse-gas-mitigation strategy or an economic stimulus effort. We found a great deal of room for improvement in the efficiency of thermal power plants across all countries due to these power plants' low operational efficiencies and high distribution losses.

Table 11 shows countries' total scores across national metrics as well as the individual country scores for each metric.

Table 11. National efforts scores by country

	Total national efforts score	Change in energy intensity	Efficiency of thermal power plants	Mandatory energy savings goals	Tax credits and loan programs	Spending on energy efficiency	Spending on energy efficiency R&D	Size of the ESCO market	Water efficiency policy
EU	19	4	2	2	3	3	2	2	1
France	19	6	0	3	3	2	2	2	1
Italy	19	4	2	2	3	5	1	1	1
UK	18	3	2	3	2	4	2	1	1
Canada	17	4	2	1	3	3	2	1	1
Germany	17	5	2	3	3	3	1	0	0
Japan	17	4	3	2	3	2	2	0	1
China	15	5	1	2	2	2	0	2	1
Spain	13	4	2	3	2	1	0	0	1
Australia	12	5	1	1	1	1	2	0	1
USA	11	1	2	0	3	3	1	1	0
South Korea	10	0	2	2	3	0	1	1	1
Russia	7	0	0	2	3	2	0	0	0
India	6	1	0	2	2	0	0	0	1
Brazil	4	0	0	1	2	0	0	0	1
Mexico	3	0	1	0	2	0	0	0	0

New in this section

The national efforts section has two new metrics assessing a portion of private-sector investment in energy efficiency (size of the energy service companies market) and water efficiency (water efficiency policy). The new metrics and the changes to existing metrics are discussed in their respective sections below.

CHANGE IN ENERGY INTENSITY (6 POINTS)

Energy intensity here is the amount of energy consumed in a country divided by national GDP. With this metric we examined change over time, from 2000 to 2011. GDP was adjusted to account for inflation over this period. Countries with a decline in energy intensity of at least 50% received 6 points, at least 45% received 5 points, at least 35% received 4 points, at least 30% received 3 points, at least 25% received 2 points, and at least 20% received 1 point (see Table 12).

Table 12. Percentage change in historical energy intensity

	Percentage change in energy intensity 2000–2011	Score
France	-50%	6
Australia	-47%	5
China	-46%	5
Germany	-45%	5
Spain	-42%	4
Canada	-40%	4
Japan	-37%	4
EU	-36%	4
Italy	-36%	4
UK	-34%	3
India	-24%	1
USA	-20%	1
South Korea	-16%	0
Brazil	-6%	0
Russia	-6%	0
Mexico	21%	0

Sources: IEA 2013a, World Bank 2013.

EFFICIENCY OF THERMAL POWER PLANTS (3 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 efficiently or inefficiently the electric power sector converts fossil fuels, through thermal combustion, into useable electricity. Since the *2012 International Scorecard*, China, Japan, and the United States have all increased the overall efficiency of their thermal power plants by 2%. Therefore, we increased by 2% the minimum levels at which points were awarded. All 3 points were awarded for overall efficiency of at least 39%, 2 points for 31%, 1 point for equal to or above 27%, and no points for countries with less than 27%.

Distribution losses are a significant factor here (see Table 13). Japan had the highest score in this metric due to the high heat-rate efficiency of its thermal power plants (46%) and its relatively low distribution losses of 5%. Brazil, in contrast, had relatively high-efficiency thermal power plants (41%), but its distribution losses of 16% resulted in a low overall score. Mexico had similar results as Brazil, with 43% thermal efficiency and 15% distribution losses. Russia had both low operational efficiency and high distribution losses as did India. The United States fell in the middle of the pack.

Table 13. Scores for efficiency of thermal power plants

	Operational efficiency of thermal power plants (%)	Distribution losses (%)	Overall efficiency of thermal power plants (%)	Score
Japan	46%	5%	41%	3
Spain	46%	9%	37%	2
South Korea	39%	3%	36%	2
UK	44%	8%	36%	2
Canada	39%	5%	34%	2
Italy	40%	7%	33%	2
USA	39%	6%	33%	2
Germany	36%	4%	32%	2
EU	38%	7%	31%	2
China	35%	6%	29%	1
Australia	34%	5%	29%	1
Mexico	43%	15%	28%	1
Brazil	41%	16%	25%	0
France	30%	5%	25%	0
Russia	28%	10%	18%	0
India	28%	21%	7%	0

Sources: WEC 2013a (thermal efficiency); IEA 2011a (distribution losses).

MANDATORY ENERGY-SAVINGS GOALS (3 POINTS)

This metric was scored according to whether a country had a policy outlining a mandatory national energy-savings goal (Table 14). National mandatory energy-savings goals can send a message across all sectors of an economy, spur innovation, and articulate national priorities. These goals measure progress toward a target, making energy efficiency more tangible and yielding quantifiable results. For example, as part of their energy-savings goal, the members of the EU are required to report annual savings achieved by their efficiency obligations, and all of the countries included in our analysis (France, Germany, Italy, Spain, and the UK) are close to achieving or surpassing their obligations (The Coalition for Energy Savings 2014). No points were awarded for voluntary goals. All 3 points were awarded for policies that require a fixed amount of energy savings per year in an amount greater than 1% of a nation's overall energy consumption. In some cases, a country received credit for an energy *intensity* target, for example, China has a goal to reduce energy intensity. In contrast, Brazil, Canada and Australia scored 1 point for national commitments to reduce greenhouse gases even though they do not have energy savings targets *per se*. The United States and Mexico had neither national energy-saving targets nor greenhouse-gas-reduction targets. Table 14 identifies countries with goals in place.

TAX CREDITS AND LOAN PROGRAMS (3 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 better meet 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 were awarded to 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.

Most countries scored the full 3 points, and except for Australia, the rest scored 2 points. Since our research for the *2012 International Scorecard,* we found that some countries have added new programs, but there were also a few countries that no longer offer incentives for efficiency, whose programs have expired, or whose programs have increased their loan interest rates. This was the case for Australia and the UK; therefore, even though the programs may still be offered, a point was subtracted from each country's score in recognition of this backsliding.

Table 14. Scores for energy savings goals, and tax credits and loan programs by country

	Mandatory energy savings goals	Score	Tax credits and loan programs	Score	Total
France	>1%	3	Loans and credits	3	6
Germany	>1%	3	Loans and credits	3	6
EU	Yes	2	Loans and credits	3	5
Italy	Yes	2	Loans and credits	3	5
Japan**	>1%	2	Loans and credits	3	5
Russia	Yes	2	Loans and credits	3	5
South Korea	Yes	2	Loans and credits	3	5
Spain	>1%	3	Loans	2	5
UK	>1%	3	Loans and credits	2	5
Canada	GHG standard	1	Loans and credits	3	4
China	Yes	2	Loans	2	4
India	Yes	2	Credits	2	4
Brazil*	GHG standard	1	Loans	2	3
USA	None	0	Loans and credits	3	3
Australia	GHG standard	1	Loans	1	2
Mexico	None	0	Credits	2	2

Sources: IEA 2013a. EEX 2012 (Australia). Nielsen 2012 (Brazil). FCM 2013 (Canada). EC 2014 (EU, France, Germany, Italy, Spain). ABB 2013g (South Korea). Energy Efficiency Watch 2014 (Spain).

**Japan's energy savings goal was established in 2006, and based on feedback from country experts we reduced the score to 2 points.
*Brazil has a climate change plan with an efficiency aim of 10% by 2030.

SPENDING ON ENERGY EFFICIENCY AND ON ENERGY EFFICIENCY RESEARCH AND DEVELOPMENT (5 POINTS/2 POINTS)

The metric measuring energy efficiency spending was 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 others, notably the United States, the utility sector is primarily regulated by states. Therefore, to be able to compare countries, we combined spending by utilities and by national governments for each country into a single metric. Table 15 reports government efficiency spending and utility spending separately, but the data were combined to arrive at countries' scores. We divided the sum of the government and utility annual investment (measured in U.S. dollars) by population. The results for this metric are an approximation of the annual spending on energy efficiency in 2011 per person in each country.

The data for this metric were among the most challenging to collect. In some cases, we utilized information about national spending that is publicly available through a budget process, while in other cases our calculation was based on an averaging of lump sum budgets for programs that span multiple years. In cases where multi-year budgets were used, we divided these budgets over the years of the program. In addition, several countries do not track separate investment data for utility energy efficiency; therefore, we assumed, where no data were found or provided, that those countries' utilities have small efficiency budgets relative to the government investment. While this metric does not examine where investments are made or measure how effectively the money is spent, it is an indication of overall commitment to energy efficiency. Since the *2012 International Scorecard*, per-capita spending decreased dramatically in Australia, Canada, Germany, and Russia. In Japan decreases in energy efficiency spending were due to the ending of economic stimulus programs, and this factor is likely to explain the decrease in some other countries (EC-IILS 2011). In contrast, the data show that Italy and the UK significantly increased their per-capita spending in recent years. Per-capita spending by the United States decreased slightly.

The awarding of points was as follows: 5 points were awarded for per-capita spending of at least $45, 4 points for at least $35 per person, 3 points for at least $25, 2 points for at least $10, and 1 point for at least $5. Table 15 lists the results by country.

Table 15. Scores for spending on energy efficiency

	Spending on energy efficiency ($/capita)	Government spending on energy efficiency ($)	Utility spending on energy efficiency ($)	Score
Italy	49	2,949,800,000	-	5
UK	41	-	2,563,524,000	4
Germany	31	2,520,000,000	-	3
Canada	28	34,634,000	942,000,000	3
EU	28	6,640,500,000	2,240,000,000	3
USA	26	821,500,000	7,300,000,000	3
Japan	23	2,910,000,000	-	2
China	13	15,151,400,000	2,610,000,000	2
France	13	855,400,000	-	2
Russia	12	1,747,000,00	-	2
Australia	8	94,455,000	90,000,000	1
Spain	7	315,294,000	-	1
Mexico	3	375,000,000	-	0
Brazil	1	28,993,000	250,000,000	0
India	0	5,172,000	6,844,000	0
South Korea	0	-	234,000	0

Sources for government spending: IEA 2013a, IEA 2013b (Germany), Gov.cn 2012 (Australia, Canada, France, Italy, Japan, Mexico, Spain), NDRC 2013 (China), PNNL 2012 (Russia), Kempener et al. 2012 (Russia and Mexico), IEA 2012c (Mexico).
Sources for utility spending: IEA 2011b, IEA 2013b (France), RAP 2012 (South Korea), IEA 2013e (Australia, Brazil, EU, and UK), CEE 2013 (Canada).

To complement the energy efficiency spending metric, we included a more narrowly defined metric measuring annual per-capita investment in energy efficiency R&D, data that are much more readily available. Australia had the highest spending in this metric followed by Canada. Countries with spending of $3 per person or more were awarded 2 points. Partial credit of 1 point was awarded to countries with spending of $1.5 per person or more. Results listed by country are shown in Table 16.

Table 16. Scoring for spending on energy efficiency R&D[2]

	Spending on energy efficiency R&D ($/capita)	Score
France	5.0	2
Australia	4.6	2
EU	4.4	2
Canada	3.9	2
UK	3.8	2
Japan	3.1	2
USA	2.8	1
Germany	2.2	1
Italy	2.1	1
South Korea	1.7	1
Spain	1.4	0
Mexico	1.3	0
China	0.0	0
Russia	0.0	0
Brazil	0.0	0
India	0.0	0

Sources for R&D efficiency spending: IEA 2011a; Kempener et al. 2012 (Brazil and China).

SIZE OF THE ENERGY SERVICE COMPANIES MARKET (2 POINTS)

An ESCO, or energy service company, is a business that develops, installs, and arranges financing for projects designed to improve the energy efficiency and maintenance costs for facilities. ESCOs generally act as project developers for a wide range of tasks and assume the technical and performance risk associated with a project. Typically, they develop, design, and arrange financing for energy efficiency projects; install and maintain the energy-efficient equipment involved; and measure, monitor, and verify the project's energy savings. These services are bundled into the project owner's cost, and the ESCO is repaid through the dollar savings generated via reduced energy costs.

[2] It should be noted that due to the inconsistencies in the availability of data on national energy efficiency spending, it is possible that some of the results include energy efficiency R&D spending in the total efficiency spending. For instance, in the United States there is likely some overlap because national spending is based, in part, on the budget of the U.S. Department of Energy Office of Energy Efficiency and Renewable Energy, which is tasked with investing in energy efficiency R&D and clean energy technology.

The presence and size of the ESCO market in a country reflects the efforts in a country to advance energy efficiency through effective business models and creative financing. France had the highest spending by ESCOs per dollar of GDP, with 2 points awarded for at least 0.05% of GDP. Partial credit of 1 point was awarded to countries with spending of at least 0.02% of GDP. Table 17 lists the results by country for both metrics.

Table 17. Scores for the size of the ESCO market relative to GDP

	Percentage of GDP	Score
France	0.23%	2
China	0.09%	2
EU	0.07%	2
Canada	0.03%	1
UK	0.03%	1
Italy	0.03%	1
USA	0.02%	1
South Korea	0.02%	1
Germany	0.01%	0
Spain	0.01%	0
Russia	0.01%	0
Japan	0.01%	0
Mexico	0.004%	0
Australia	0.002%	0
Brazil	0.001%	0
India	0.001%	0

Sources: AEEC 2014 (Australia); IEA 2013b (EU and Russia); Bobbino, Galván, and González-Eguino 2013 (Spain); Crossley 2013 (China); Seligsohn and Hsu 2011 (China); Delio, Lall, and Singh 2010 (India); Marino, Bertoldi, and Rezessy 2010 (France, Germany, Italy, Russia, UK).

WATER EFFICIENCY POLICY (1 POINT)

Energy demand can also be reduced through investments aimed at reducing water demand. Water and energy are inherently linked, intersecting at both the supply side (electricity generation and water/wastewater facilities) and the end-use side (residential, commercial, industrial, and agriculture sectors). This energy-water nexus is apparent in the massive amounts of water needed to produce and deliver electricity. Coal, nuclear, and solar-thermal electricity generation are water intensive. Water is needed to create steam and to power turbines, water is also withdrawn for cooling and then either lost in the process or discharged back into the environment. Conversely, it takes immense amounts of energy to clean and transport water. Water and wastewater utilities consume large amounts of energy to treat

water—often running pumps, motors, and building equipment. On the end-use side, energy and water are connected in our homes, businesses, and industrial facilities. This close relationship means that improvements in water efficiency generally result in energy savings.

Countries can improve their energy efficiency by implementing mandates for water savings and water conservation. The European Water Framework Directive includes water management plans that countries must implement, plans including water-pricing policies that provide incentives for water efficiency. The UK implemented the European Directive, and its water industry set up and funded an organization called Waterwise to make the case for large-scale water conservation and launched the UK's first water efficiency label to help consumers choose water-efficient products. The label is given to products designed to improve water efficiency and reduce waste.

Many countries have some type of water efficiency policy (see Table 18). For this metric we did not investigate the enforcement or effectiveness of these policies. One point was awarded to countries with national water policies that specifically require measures that improve water efficiency or water savings.

Table 18. Scores for water efficiency policy

	Water policy	Score
Brazil	Yes	1
Canada	Yes	1
China	Yes	1
EU	Yes	1
France	Yes	1
India	Yes	1
Italy	Yes	1
Japan	Yes	1
South Korea	Yes	1
Spain	Yes	1
UK	Yes	1
Australia*	Yes	1
Germany	No	0
Mexico	No	0
Russia	No	0
USA	No	0

Sources: Commonwealth of Australia 2013 (Australia); ANA 1999 (Brazil); Environment Canada 2014 (Canada); CWR 2013. (China); EU 2010 (EU, Spain); Ministry of Ecology, Sustainable Development, Transport and Housing 2012 (France); Giannoccaro 2010 and Munaretto 2013 (Italy); Cámara de Diputados Del H. Congreso De La Unión. 2013 (Mexico); Kim et al 2007 (S. Korea); Water UK 2011 (UK).

*Australia has no national water efficiency policy but has made substantial strides to improve water efficiency as a result of actions by most states.

NATIONAL EFFORTS BEST PRACTICES

European Union. The EU scored high in the national metrics due to its members' strides in implementing national energy efficiency policies and their relatively high energy efficiency performance. The EU implemented the Directive on Energy Efficiency in December 2012 (2012/27/EU) that establishes a 20% by 2020 energy efficiency goal and a common framework of measures for the promotion of energy efficiency to ensure its achievement. The directive also paves the way for further energy efficiency improvements beyond that date. This policy drives every nation within the EU to put in place a policy and plan to reduce its energy consumption. In addition, energy providers across the EU have high levels of efficiency spending per capita, with $2.5 billion USD spending across the 27 countries within the EU. Similarly, collectively, the countries of the EU have invested relatively great amounts in energy efficiency research and development, which helps spur innovation in energy efficient technologies.

Japan. After the electricity shortage that occurred in the wake of nuclear disaster in Japan in 2011, the government took various national electricity-saving measures including an electricity-savings plan with a strict target to reduce electricity use from the general public by 15% during summer months. In addition to its mandatory energy-savings goal, Japan demonstrates a strong commitment to energy efficiency spending, with major investments through its tax and loan program and in research and development. The national government promotes subsidies and tax benefits to purchasers of electric vehicles and plug-in hybrids, supports home energy management and building energy management programs, and promotes zero-energy buildings and zero-energy home programs.

Figure 4. Best practices in the national efforts section

Buildings

Countries could earn up to 25 points across eight different metrics for energy efficiency 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 the energy consumption of products is disclosed.

The top-scoring country in the buildings section was China, followed by Germany. The EU and France tied for third. China scored well on its energy intensity in residential and commercial buildings, appliance and equipment standards, and appliance and equipment labeling. Many European countries scored well on building codes, while many countries with economies in an earlier stage of development scored well on building energy use. Building codes and labels disclosing energy use by appliances and equipment seem to be fairly standard practices across countries. Building labeling and performance standards for appliances and equipment are also standard practices, although the comprehensiveness of the building labeling programs and the number of appliances covered by standards vary by country. Table 19 lists countries' total scores in the buildings section and scores for each metric.

Table 19. Buildings sector scores by country

	Total buildings score	Energy intensity in residential buildings	Energy intensity in commercial buildings	Residential building codes	Commercial building codes	Building labeling	Appliance and equipment standards	Appliance and equipment labeling	Building retrofit policy
China	19	4	4	2	2	1	4	2	0
Germany	17	1	2	3	3	2	2	2	2
EU	16	1	2	3	3	2	2	2	1
France	16	1	1	3	3	2	2	2	2
Australia	15	2	0	3	3	2	2	2	1
Canada	15	2	2	2	2	0	5	1	1
Spain	15	2	0	3	3	2	2	2	1
UK	14	0	2	3	3	2	2	2	0
USA	14	2	1	2	2	0	5	1	1
Italy	13	1	0	3	2	2	2	2	1
Japan	13	2	0	2	3	1	2	2	1
Mexico	13	4	4	0	1	0	3	1	0
India	12	3	4	0	2	0	0	2	1
South Korea	12	0	1	3	3	0	3	2	0
Brazil	10	4	3	0	0	0	1	2	0
Russia	6	0	1	1	1	1	0	1	1

New in this section

The buildings section has a new metric looking at building retrofit policies. We have also improved the building code and building energy intensity metrics. The new metric and changes to existing metrics are discussed in their respective sections below.

ENERGY INTENSITY IN RESIDENTIAL AND COMMERCIAL BUILDINGS (4 POINTS EACH)

These two metrics were calculated using the total energy consumption in buildings divided by the floor space of the building stock. To normalize these results, we factored in differences in seasonal temperatures by taking average of the total population-weighted heating and cooling degree days for each country (ChartsBin 2011a and 2011b) to get a heating and cooling factor for each country.[3] We then divided energy consumption per square foot by the heating and cooling factor. This calculation helps to account for the varying impact of temperature and requirements for heating or cooling that are inherent in living in cooler or warmer climates as well as account for the dispersion of a population across those different climates. This allows for more accurate comparisons of countries' energy intensity in buildings related to efficiency improvements, rather than just the impact of climate.

The results for this metric 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. As a result, the lowest energy intensity does not necessarily equate to the most energy-efficient buildings nor does energy intensity indicate the level of comfort experienced in buildings. China and Mexico have the best scores for this metric for both residential and commercial buildings, followed by Brazil and India, due in part to the availability of fewer overall energy services (e.g., no heating or cooling systems in homes) than in many of the other countries analyzed. Russia, South Korea, and Italy, scored poorly on this metric. In particular, Italy and Australia had two of the highest energy intensities in the commercial sector, while Russia and South Korea had the highest energy intensities in the residential sector. Table 20 shows how the results were scored, and the results and scores are presented in Table 21.

[3] A heating degree day is a measure of weather that triggers a need for space heating. A cooling degree day is a measure of weather that triggers a need for space cooling. The average heating and cooling needs of an entire country can be determined by applying population weightings to the degree day calculations generated for locations within a country. Using population to weight the degree-day data ensures that large metropolitan areas are accorded more weight than sparsely populated areas so that the national average reflects the heating and cooling needs faced by the "average" citizen of that country (with some facing more, and others facing less) (Baumert and Selman 2003).

Table 20. Point allocation for metrics for energy intensity in buildings

Points	Residential (Btu/f²)	Commercial (Btu/f²)
4	5	5
3	10	20
2	15	30
1	20	40

Table 21. Scores for energy intensity in residential and commercial buildings

	Energy intensity in residential buildings			Energy intensity in commercial buildings		
	(Btu/f²)	(kJ/m²)	Score	(Btu/f²)	(kJ/m²)	Score
China	1.0	11.9	4	4.3	48.7	4
Mexico	1.4	15.4	4	2.9	33.4	4
Brazil*	4.3	49.0	4	17.0	193.0	3
India	8.1	92.3	3	2.2	25.1	4
Canada	13.5	152.8	2	29.1	331.0	2
EU	17.9	203.4	1	27.4	311.5	2
Germany	17.4	197.7	1	23.2	263.9	2
USA	13.1	148.4	2	32.8	372.2	1
Australia	13.8	157.1	2	48.7	553.1	0
France	19.9	225.6	1	32.2	366.2	1
UK	21.1	239.9	0	25.0	284.4	2
Japan	13.4	152.1	2	46.7	530.8	0
Spain	12.4	141.2	2	43.9	499.0	0
Italy	18.9	214.9	1	58.1	659.4	0
Russia	24.9	282.8	0	32.9	373.4	1
South Korea	22.2	252.5	0	35.0	397.6	1

Note: *Energy intensity in Brazil is for Rio de Janeiro only due to data limitations.

Sources: Energy consumption in buildings: IEA 2014. Floor space: BPIE 2011 (all European countries); Langham et al. 2010 (Australia); in-country contact (India). Statistics: IEEJ 2014 (Japan); Lychuk et al. 2012 (Russia); KOSTAT 2010 (South Korea); Navigant 2014 (Mexico). Heating degree days and cooling degree days: ChartsBin 2011a, 2011b.

RESIDENTIAL AND COMMERCIAL BUILDING CODES (3 POINTS EACH)

Scores for residential and commercial building codes were based on the presence of national, mandatory building codes covering six major areas, including requirements for:

- *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.

- *Low U-factors and shading/solar heat gain coefficient for windows.* The U-factor measures the rate of heat transfer through a window and rates how well the window insulates. The solar heat gain coefficient measures the fraction of solar energy transmitted, indicating how well the window blocks heat from solar radiation.

- *Efficient lighting.* Minimum standards for high-efficiency lighting, lamps, and/or lighting controls are included in some building codes.

- *Efficient heating, ventilating, and air conditioning systems.* Some building codes require a certain level of efficiency in heating, ventilating, and cooling systems to ensure that energy is not wasted from inefficient equipment.

- *Proper design, position, and orientation*. Design requirements include architectural programing requirements for all the functions in the building and their relationship to one another including occupancy and time of use, daylight potential, indoor environmental quality standards, equipment and plug loads, acoustic quality, safety, and security.

- *Air sealing (residential buildings only).* Getting rid of air leaks throughout a home, such as around windows and doors, attics, basements, and crawlspaces, reduces the loss of heated or cooled air.

One point was awarded to countries with either mandatory building codes that cover their commercial and residential sectors or codes that cover the majority of their populations ("mixed"). Countries with voluntary or no codes did not receive this point. We then allocated the remaining 2 points based on the number of prescriptive and technical requirements from the bulleted list above that are included in the code. If all but one of the elements from the list were included in the code, 1 point was awarded. If all elements were included, 2 points were awarded. Table 22 and Table 23 list the major areas scored for residential and commercial buildings and the results for each country.

Table 22. Scores for residential building codes

	Code status	Heating and cooling requirements	Insulation in walls and ceiling	Window U-factor and shading/solar heat gain coefficient	Air sealing	Lighting efficiency	Design, position, and orientation	Score
Australia	Mandatory	Y	Y	Y	Y	Y	Y	3
Germany	Mandatory	Y	Y	Y	Y	Y	Y	3
EU	Mandatory	Y	Y	Y	Y	Y	Y	3
Italy	Mandatory	Y	Y	Y	Y	Y	Y	3
South Korea	Mandatory	Y	Y	Y	Y	Y	Y	3
Spain	Mandatory	Y	Y	Y	Y	Y	Y	3
UK	Mandatory	Y	Y	Y	Y	Y	Y	3
France	Mandatory	Y	Y	Y	Y	Y	Y	3
China**	Mixed	Y	Y	Y	Y	Y	Y	2
Canada***	Mixed	Y	Y	Y	Y	Y	Y	2
Japan	Mixed	Y	Y	Y	Y	N	Y	2
USA*	Mixed	Y	Y	Y	Y	Y	N	2
Russia	Mandatory	Y	Y	N	N	Y	N	1
Brazil	Voluntary	NA	NA	NA	NA	NA	NA	0
India	Voluntary	NA	NA	NA	NA	NA	NA	0
Mexico	None	NA	NA	NA	NA	NA	NA	0

*The U.S. federal government does not have authority to pass mandatory building codes; however, the majority of states have adopted codes. The U.S. score is based on states' codes.

** China was awarded 2 points because building codes do not apply to rural areas, which represent more than half of the building stock; however, building codes are in place for both commercial and residential buildings in urban areas. These codes are stringent, and China has made extensive efforts to enforce the standards.

***Canada's federal government does not have authority to pass mandatory building codes; however, Canada was awarded 2 points based on building codes that have been adopted in several provinces, representing the majority of the population.

Sources: IEA 2013d; BCAP 2014; GBPN 2013; McDonald and Lausten 2013; CLASP 2011; Il Presidente della Repubblica 2005 (Italy); Evans et al. 2009 (Japan).

Table 23. Scores for commercial building codes

	Code Status	Heating and cooling requirements	Insulation in walls and ceiling	Window U-factor and shading/solar heat gain coefficient	Lighting efficiency	Design, position, and orientation	Score
Australia	Mandatory	Y	Y	Y	Y	Y	3
Germany	Mandatory	Y	Y	Y	Y	Y	3
EU	Mandatory	Y	Y	Y	Y	Y	3
South Korea	Mandatory	Y	Y	Y	Y	Y	3
Spain	Mandatory	Y	Y	Y	Y	Y	3
UK	Mandatory	Y	Y	Y	Y	Y	3
France	Mandatory	Y	Y	Y	Y	Y	3
Japan	Mandatory	Y	Y	Y	Y	Y	3
China**	Mixed	Y	Y	Y	Y	Y	2
Canada***	Mixed	Y	Y	Y	Y	Y	2
India	Voluntary	Y	Y	Y	Y	Y	2
Italy	Mandatory	Y	Y	Y	Y	N	2
USA*	Mixed	Y	Y	Y	Y	N	2
Mexico	Mandatory	Y	Y	N	Y	N	1
Russia	Mandatory	Y	Y	N	N	Y	1
Brazil	None	NA	NA	NA	NA	NA	0

*The U.S. federal government does not have authority to pass mandatory building codes; however, the majority of states have adopted codes. The U.S. score is based on states' codes.

**China was awarded 2 points because building codes do not apply to rural areas, which represent more than half of the building stock; however, building codes are in place for both commercial and residential buildings in urban areas. These codes are stringent, and China has made extensive efforts to enforce the standards.

***Canada's federal government does not have authority to pass mandatory building codes; however, Canada was awarded 2 points based on building codes that have been adopted in several provinces, representing the majority of the population.

Sources: IEA 2013d; BCAP 2014; GBPN 2013; McDonald and Lausten 2013; CLASP 2011; Il Presidente della Repubblica 2005 (Italy); Evans et al. 2009 (Japan).

These scores do not take into account the relative thoroughness of building code implementation nor do we discuss the enforcement of building codes in individual countries, largely because of insufficient data. However, carrots and sticks are crucial to ensuring the effective implementation of and compliance with building energy codes, and more research is required to fully understand the impact that building codes are having on energy use in many countries.

BUILDING LABELING (2 POINTS)

Scores for the next buildings-related metric were 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 mpg rating for a vehicle. Disclosure of a building's energy use can assist in owners or lessees recognizing the value of energy efficiency benefits at the time of a purchase or lease. The full 2 points were given to countries with disclosure and labeling requirements applicable to all buildings (new and existing, commercial and residential). One point was awarded to countries with national policies that apply to new buildings and are triggered for existing buildings upon a sale, lease, or remodel; with national policies that apply only to new buildings or only to a subset of buildings (commercial but not residential); or in which there are substantial state and local policies. Table 24 lists the findings for this metric.

Table 24. Scores for building labeling programs by country

	Building energy labeling and disclosure	Score
Australia	Mandatory for all buildings	2
EU	Mandatory for all buildings	2
France	Mandatory for all buildings	2
Germany	Mandatory for all buildings	2
Spain	Mandatory for all buildings	2
UK	Mandatory for all buildings	2
Italy	Mandatory for all buildings	2
China	Mandatory for some buildings	1
Japan	Mandatory for some buildings	1
Russia	Mandatory for some buildings	1
USA	Voluntary	0
Brazil	Voluntary	0
Canada	Voluntary	0
India	Voluntary	0
South Korea	Voluntary	0
Mexico	None	0

Sources: Buildingrating.org 2014; Kulagin 2011 (Russia).

APPLIANCE AND EQUIPMENT STANDARDS (5 POINTS)

Policies specifying/requiring minimum energy performance standards for appliances and equipment were eligible for up to 5 points. Points were awarded based on the number of appliances and types of equipment covered by the 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. Canada and the United States stand out in this category for having energy performance standards that cover the highest number of products, followed by China and Mexico. Table 25 shows point thresholds, and Table 26 shows the scores and ranks.

Table 25. Point allocation for appliance and equipment standards and labeling

Points	Number of appliance and equipment standards
5	35
4	30
3	25
2	20
1	15

LABELING OF APPLIANCE AND EQUIPMENT ENERGY EFFICIENCY (2 POINTS)

Labeling 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. An example of a categorical label is the EU's scheme, which awards a letter grade to a product. The EnergyGuide program in the United States is a continuous labeling program. See Figure 5.

Categorical	Continuous

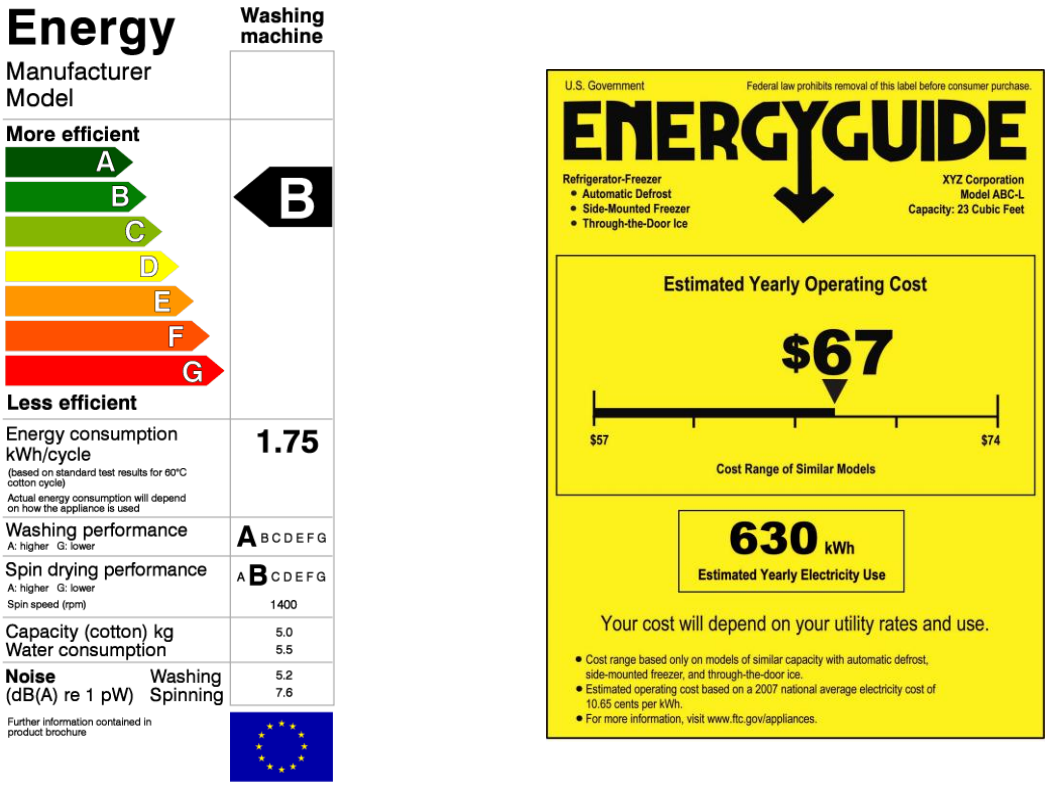


Figure 5. Sample appliance labels

Research on label design and effectiveness conducted in many countries repeatedly demonstrates that categorical labels are easier to understand and use, and are more motivating for consumers and manufacturers. Experience in countries with categorical and continuous labels bears out the research: categorical labels are more effective in driving manufacturers to offer and consumers to purchase higher-efficiency products than are continuous label designs.

Countries with policies that include mandatory disclosure of the energy consumption of appliances and equipment using a categorical format were awarded 2 points. We awarded 1 point to countries with mandatory labeling using a continuous approach, since in some cases a labeling program with continuous labels that covers many products can save just as much energy overall as a categorical program covering fewer products. Results for this metric are included in Table 26.

Table 26. Scores for standards and labeling of appliances and equipment

	Appliance and equipment standards	Score	Appliance and equipment labeling	Score
USA	45	5	Mandatory; continuous	1
Canada	44	5	Mandatory; continuous	1
China	34	4	Mandatory; categorical	2
Mexico	28	3	Mandatory; continuous	1
South Korea	27	3	Mandatory; categorical	2
Australia	24	2	Mandatory; categorical	2
Japan	24	2	Mandatory; categorical	2
EU	20	2	Mandatory; categorical	2
France	20	2	Mandatory; categorical	2
Germany	20	2	Mandatory; categorical	2
Italy	20	2	Mandatory; categorical	2
Spain	20	2	Mandatory; categorical	2
UK	20	2	Mandatory; categorical	2
Brazil	15	1	Mandatory; categorical	2
India	4	0	Mandatory; categorical	2
Russia	1	0	Mandatory; continuous	1

Sources: Number of equipment standards: CLASP 2013a. Appliance and labeling standards: CLASP 2013b; Energy Efficiency Watch 2014 (Spain); ICF International 2011 (South Korea).

BUILDING RETROFIT POLICIES (2 POINTS)

Globally, existing building stocks tend to be old and inefficient, providing a tremendous opportunity for energy savings. Countries can more fully capture those savings by adopting policies to reward improved efficiency during a building redesign or retrofit. In many cases countries will adopt building energy codes for existing buildings, meaning that building retrofit policies are tied in with building codes. All European countries in this *Scorecard* have mandatory building energy codes for existing buildings, which include a minimum energy performance standard (IEA 2013d). There are also stand-alone policies for building retrofits that a country can adopt, independent of building codes. For example, there are financial policies a country can adopt such as requiring lenders to incorporate energy performance into the application for loans.

For this metric we awarded 2 points to countries with comprehensive (residential and commercial) building retrofit policies in place. Countries with partial building retrofit policies, such as policies that apply only to residential or commercial buildings or only to certain areas of the country, were awarded 1 point, and countries without a policy received no points. France and Germany have made strides in incorporating building retrofits into their building energy

policies. Japan also has building retrofit policies. The United States received partial credit for its building energy code for renovated buildings. Table 27 summarizes the scores for each country.

Table 27. Scores for building retrofit policies

	Building retrofit policies	Score
France	Yes	2
Germany	Yes	2
Japan	Partial	1
Australia	Partial	1
Canada	Partial	1
EU	Partial	1
India	Partial	1
Italy	Partial	1
Russia	Partial	1
Spain	Partial	1
USA	Partial	1
Brazil	None	0
South Korea	None	0
UK	None	0
China	None	0
Mexico	None	0

Source: IEA 2013d; BASIX 2014 (Australia); EnEV 2009 (Germany); Amecke et al. 2013 (China, Germany, United States)

BEST PRACTICES IN THE BUILDINGS SECTOR

China. China has a rapidly growing building stock, including rapid urban development and demolition of older buildings. As a result, new building energy codes are highly effective at reducing energy consumption. China's energy efficiency policy is driven at the federal level and carried out by provinces and municipalities. China's building energy efficiency standards require new buildings to be up to 65% more efficient than buildings from the early 1980s. China also has enforcement mechanisms that include incentives and penalties for non-compliance.

Several building labeling efforts are underway led by China's Ministry of Housing and Urban-Rural Development (MOHURD), which developed an official Chinese Green Building Design Label also known as "Three Star" to certify and rate buildings. Labeling in China is mandatory for many commercial buildings including large office buildings, those undergoing publicly funded retrofits, and green-labeled buildings. China also has mandatory appliance and equipment standards and a labeling program that covers a significant number of products. In addition to its noteworthy policy efforts, China was one of just two countries to receive the maximum possible points for buildings performance metrics due to its low energy use in both residential and commercial buildings.

Germany. Germany scored low on energy intensity in residential and commercial buildings but scored high overall for its progressive energy efficiency policies. Germany has mandatory building codes covering the residential and commercial sectors and has code requirements for new buildings that are also applicable to existing buildings if refurbishments change exterior elements by more than 10%. Its codes are comprehensive and include a variety of technical elements, most notably, information on technical installations and design requirements. Germany also has several other policies in place such as building retrofit policies, building labeling and disclosure policies, and mandatory appliance and equipment labeling.

Germany's new building labeling project, TOP 100 – Eco-label for Climate-Relevant Products, is one example of the ways that it is advancing efficiency in buildings. The TOP 100 label aims to improve the energy efficiency in product standards and to promote the development of climate-protection-related eco-labels.

Figure 6. Best practices in the buildings sector

Industry

Countries could earn up to 25 points across seven different metrics for energy efficiency in the industrial sector. Countries were scored based on performance criteria including the industrial sector's energy intensity, how much of the sector's electricity comes from CHP, and investment in industrial R&D. The policy metrics we evaluated look to government efforts to encourage energy efficiency in the industrial sector through incentives, the implementation of voluntary programs to set energy savings targets, and mandates requiring periodic energy audits and on-site energy managers.

Germany received the top score with 18 points followed by Australia, Italy, and the EU tied for second. The top-scoring countries generally had lower energy intensities, a high percentage of industrial electricity generated by CHP, and voluntary government programs aimed at improving the energy efficiency of partnering businesses.

The policies that countries have adopted to address energy efficiency of the industrial sector vary quite a bit, and no country received a perfect score in all three policy metrics. The European countries did a consistently good job across all metrics, and they stand out for their voluntary agreements and incentives available to manufacturers. All countries have significant room for improvement. Table 28 lists the sector total and scores by individual metrics for each country.

Table 28. Industry sector scores by country

	Total industry score	Energy intensity of the industrial sector	Industrial electricity generated by combined heat and power	Investment in manufacturing research and development	Voluntary energy-performance agreements with manufacturers	Mandate for plant energy managers	Mandatory energy audits	Agriculture energy intensity
Germany	18	6	4	1	3	0	2	2
Australia	15	8	1	1	3	0	2	0
EU	15	4	5	0	3	0	2	1
Italy	15	3	6	0	3	2	0	1
China	13	0	5	0	2	2	2	2
France	12	4	1	1	3	0	2	1
Japan	12	2	1	2	2	2	2	1
South Korea	12	1	3	2	3	0	2	1
Spain	12	4	2	0	2	0	2	2
India	11	0	1	2	2	2	2	2
Russia	11	0	5	0	3	0	2	1
UK	10	2	2	2	3	0	0	1
USA	9	3	2	2	2	0	0	0

	Total industry score	Energy intensity of the industrial sector	Industrial electricity generated by combined heat and power	Investment in manufacturing research and development	Voluntary energy-performance agreements with manufacturers	Mandate for plant energy managers	Mandatory energy audits	Agriculture energy intensity
Canada	7	3	0	1	3	0	0	0
Mexico	3	1	1	0	0	0	0	1
Brazil	2	1	0	1	0	0	0	0

New in this section

The industry section has a new metric looking at energy intensity in agriculture. We have also improved the energy intensity metric so that the results are weighted by types of industry. The new metric and changes to existing metrics are discussed in their respective sections below.

ENERGY INTENSITY OF INDUSTRIAL SECTOR (8 POINTS)

This metric is a measure of the consumption of energy in the industrial sector[4] (measured in British thermal units (Btu)) divided by industrial GDP in U.S. dollars. Energy intensity varies significantly among the 12 industries analyzed for each country, and the mix varies significantly among the countries. In order to fairly compare the energy intensities of the overall industrial sectors among the countries, it was necessary to normalize the industrial energy intensity of each country to account for variation in the mix of industries.

Energy intensity values are not consistently available across countries, so we normalized the data using U.S. intensities by type of industry. This adjustment implicitly assumes that the pattern of relative intensities among a country's industries would be similar. For manufacturing industries we used the average intensity of energy consumption per dollar of value of shipments reported in Table 6.3 of the *2010 Manufacturing Energy Consumption Survey* (EIA 2013). For the non-manufacturing industry (mining), we calculated the energy intensity based on energy consumption and value of shipments reported in Supplemental Tables 33 and 44 the *2014 Annual Energy Outlook Final Release* (EIA 2014).

The U.S. industry intensities were multiplied by the energy consumption for each country's industries. We then summed across all of the industries to produce an intensity factor reflecting

[4] This number includes the following industrial sectors: iron and steel, chemical and petrochemical, non-ferrous metals, non-metallic minerals, transport equipment, machinery, mining and quarrying, food and tobacco, paper, pulp and printing, wood and wood products, textile and leather, and non-specified (industry). This number does not include energy consumption in agriculture.

the relative energy intensity of the country's industrial sector (relative intensity factors are included in Table 30). These factors were normalized to the average of all countries in the study. These country-intensity weighting factors were then used to adjust each country's intensity value to create a weighted intensity.

Countries with the lowest weighted energy consumption per dollar of industrial GDP (less than 2 Btu per dollar of industrial GDP) in the industrial sector were awarded 8 points. Table 29 shows the breakdown of points, and Table 30 lists the results by country.

Table 29. Point allocation for energy intensity of the industrial sector

Points	Btu per dollar of industrial GDP
8	1.5
7	2
6	2.1
5	2.2
4	2.4
3	2.8
2	3
1	6

Table 30. Scores for energy intensity of the industrial sector

Country	Relative intensity factor	Energy intensity of sector		Score
		(Btu/$)	(joules/$)	
Australia	1.63	1.35	1,420	8
Germany	1.12	2.03	2,139	6
France	1.01	2.28	2,406	4
Spain	1.01	2.31	2,437	4
EU	1.11	2.33	2,456	4
Italy	0.95	2.47	2,606	3
Canada	1.72	2.51	2,647	3
USA	1.36	2.69	2,841	3
Japan	0.73	2.93	3,091	2
UK	0.67	2.97	3,136	2
Mexico	0.58	4.98	5,253	1
Brazil	1.02	5.41	5,712	1
South Korea	0.80	5.24	5,524	1
Russia	1.04	6.71	7,080	0

Country	Relative intensity factor	Energy intensity of sector (Btu/$)	Energy intensity of sector (joules/$)	Score
China	0.90	9.24	9,752	0
India*	NA	NA	NA	0

Sources for energy consumption of industrial sector: IEA 2014; CIA 2013; World Bank 2013. Industrial GDP is based on the percentage of total GDP (World Bank) attributable to the industrial sector (CIA).

*Score based on ACEEE estimate due to unreliable data.

ELECTRICITY GENERATED BY COMBINED HEAT AND POWER (6 POINTS)

CHP systems generate useful thermal energy and electricity or mechanical power in a single, integrated system. The use of CHP systems is 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 thermal demands.

Scores were awarded according to the percentage of a country's electricity consumption that is produced by CHP. There was a wide range of results across countries. Italy had the highest percentage of electricity generated from CHP and had nearly 10% more electricity generated from CHP than the economy receiving the next highest score, the EU. In contrast, Canada and Brazil use very little CHP to meet their electricity needs.

Countries with at least 20% of their electricity generated from CHP were awarded the full 6 points. Table 31 shows the scoring, and Table 32 lists the results by country.

Table 31. Point allocation for electricity generated combined heat and power

Points	Percentage of industrial power from CHP
6	20%
5	14%
4	12%
3	10%
2	6%
1	2.5%

Table 32. Scores for electricity generated by combined heat and power

	Electricity generated by CHP (%)	Score
Italy	24.1%	6
EU	14.4%	5
China	14.0%	5
Russia	14.0%	5
Germany	13.3%	4
South Korea	11.6%	3
Spain	6.6%	2
UK	6.5%	2
USA	6.3%	2
India	5.0%	1
Mexico	4.6%	1
France	4.4%	1
Japan	3.0%	1
Australia	2.5%	1
Canada	1.8%	0
Brazil	<1%	0

Sources: WEC 2013b; CEN 2011 (China); IEA 2010 (India); IEA 2008 (Brazil, and China); SENER 2013 (Mexico).

INVESTMENT IN MANUFACTURING RESEARCH AND DEVELOPMENT (2 POINTS)

While manufacturing R&D spending is not exclusively invested in energy efficiency, energy efficiency is a major focus of R&D investments as it reduces waste and energy costs and improves competitiveness. Spending included in this metric, therefore, represents R&D activities carried out in the business enterprise sector, regardless of the origin of funding. We divided total R&D spending in the manufacturing sector by industrial GDP and report the result in U.S. dollars. The full 2 points were awarded to countries with spending of equal to or more than 5% of industrial GDP, and 1 point was awarded for spending of equal to or more than 3% of industrial GDP. Japan had the highest relative spending with investments in manufacturing R&D equal to nearly 10% of industrial GDP. The United States followed with 9%. Table 33 lists the results.

Table 33. Scores for investment in manufacturing research and development

	Investment in industrial R&D (Percentage of industrial GDP)	Score
Japan	9.6%	2
USA	8.9%	2
India	7.9%	2
South Korea	6.7%	2
UK	5.4%	2
Brazil	4.4%	1
Australia	4.4%	1
France	4.2%	1
Germany	3.8%	1
Canada	3.1%	1
China	2.7%	0
EU	2.0%	0
Italy	1.5%	0
Spain	1.5%	0
Russia	1.4%	0
Mexico	0.4%	0

Sources: IEA 2014; UNESCO 2010 (Brazil); EC 2012; IBEF 2014 (India).

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

The scoring for this metric was 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 of 3 points was 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 were awarded 2 points. Several countries stood out in this area, including Russia, France, Italy, Canada, Germany, and the UK. Table 34 lists the results of this metric by country.

Mandate for Plant Energy Managers (2 points)

This metric was scored according to whether or not a country had a national law or regulation requiring industrial facilities to employ an energy management expert on site (see Table 34). A dedicated, on-site energy manager can improve processes, identify waste, and maximize the efficient use of energy resources. However, in spite of the economic benefits of reduced energy waste and increased economic productivity that can come from having an on-site expert, only

four of the countries analyzed had such a requirement: Japan, China, India, and Italy. Countries that had a plant energy manager mandate received 2 points.

MANDATORY ENERGY AUDITS (2 POINTS)

Periodic energy audits can help businesses identify opportunities to improve energy efficiency, benchmark improvements, and identify negative trends. Russia, Japan, China, India, France, Germany, Spain, South Korea, the EU, and Australia had such a requirement (see Table 34). Countries were awarded 2 points if there was a national law or regulation requiring periodic energy audits of industrial facilities.

Table 34. Scores for industrial policies to encourage energy efficiency: voluntary agreements, energy plant managers, and audits

	Voluntary agreements with manufacturers	Score	Mandate for plant energy manager	Score	Mandatory energy audits	Score	Combined score
China	Agreement or incentives	2	Y	2	Y	2	6
India	Agreement or incentives	2	Y	2	Y	2	6
Japan	Agreement or incentives	2	Y	2	Y	2	6
Australia	Agreement and incentives	3	N	0	Y	2	5
EU	Agreement and incentives	3	N	0	Y	2	5
France	Agreement and incentives	3	N	0	Y	2	5
Germany	Agreement and incentives	3	N	0	Y	2	5
Italy	Agreement and incentives	3	Y	2	N	0	5
Russia	Agreement and incentives	3	N	0	Y	2	5
South Korea	Agreement and incentives	3	N	0	Y	2	5
Spain	Agreement or incentives	2	N	0	Y	2	4
Canada	Agreement and incentives	3	N	0	N	0	3
UK	Agreement and incentives	3	N	0	N	0	3
USA	Agreement or incentives	2	N	0	N	0	2
Brazil	None	0	N	0	N	0	0
Mexico	None	0	N	0	N	0	0

Sources: ABB 2011 and 2012a-h; IEA 2012a (France); IEA 2012b (Germany).

AGRICULTURE ENERGY INTENSITY (2 POINTS)

For this second edition of the *International Scorecard* we broke out the energy intensity of agriculture and forestry to give a more accurate representation of the energy efficiency in this very energy-intensive and economically important sector. Agricultural production relies on the use of energy from fossil fuel resources. There is a direct consumption of fuel and electricity required to execute different crop production practices and an indirect use of energy required for the production of agricultural inputs, such as fertilizers and pesticides.

The countries with the lowest energy intensity in the agricultural sector were India, Germany, Spain, and China. The full 2 points were awarded for countries with an energy intensity of less than 0.050 kilotonne of oil equivalent (ktoe) per agricultural GDP. Countries with intensity less than 0.100 ktoe per agricultural GDP were awarded 1 point (see Table 35).

Table 35. Scores for agriculture energy intensity

	Agriculture/forestry energy intensity (ktoe/agricultural GDP)	Score
India	0.018	2
Germany	0.034	2
Spain	0.046	2
China	0.048	2
Russia	0.052	1
Japan	0.057	1
South Korea	0.061	1
Mexico	0.069	1
UK	0.073	1
EU	0.079	1
France	0.084	1
Italy	0.096	1
Australia	0.100	0
Brazil	0.100	0
USA	0.116	0
Canada	0.200	0

Source: WEC 2013c.

INDUSTRY BEST PRACTICES

Germany. Overall, Germany has a low industrial energy intensity relative to other countries. In addition, Germany has enacted several policies to reward and drive greater efficiency in its manufacturing sector. For example, Germany has voluntary energy-savings targets for manufacturers to improve their energy efficiency. However, its advances in industrial efficiency are largely driven by its economic incentives. Germany has programs that support greater energy efficiency in manufacturing production processes by providing subsidies for upgrading technology and equipment. Germany also targets small and medium-sized enterprises, helping them improve the efficiency of their facilities by providing 30% of the funding for energy-efficient motors, pumps, air-conditioning systems, and compressed air devices.

Italy. Italy has the highest use of CHP for power generation of all countries analyzed, potentially due to its policies to advance CHP. Italy has implemented a policy that ensures premium prices for the production of energy from "assimilated" sources (corresponding to CHP or waste-to-energy power plants) for the first eight years of these systems' electricity generation. This program, called the CIP6 programme, has spurred the development of CHP across the country since the mid-1990s. In addition, Italy's the Legislative Decree No. 20/2007 called for an increase in the use of high-efficiency cogeneration in industry. To accomplish this, the legislation created incentives to support the diffusion of this technology in manufacturing and industrial facilities. Incentives were for high-efficiency motors and inverters, mechanical vapor compression, and, more broadly, high-efficiency cogeneration.

Australia. Australia has a very low weighted energy intensity in industry, despite having an industrial sector made up of energy-intensive industries such as steel, chemicals, and industrial and transportation equipment. Australia has made strides to improve the energy efficiency of its industrial sector through a series of policies and programs. In 2011, the Australian government introduced the Clean Energy Future package, which included a number of energy efficiency initiatives such as an AUD800 million Clean Technology Investment Program. This program provides grant funding for investment in energy-efficient capital equipment and low-emissions technologies, processes, and products and is open to manufacturers that meet a minimum energy or emissions threshold. The government also established an assistance website called the Energy Efficiency Exchange, which supports the implementation of energy efficiency practices within medium- and high-energy-using companies (http://eex.gov.au/). However, in 2013, the Australian government introduced several bills to repeal the Clean Energy Future Package, and the outcome of this legislative process will be reflected in future editions of this *Scorecard*.

Figure 7. Best practices in the industry sector

Transportation

Countries could earn up to 25 points across eight different metrics for energy efficiency in the transportation sector. Countries were evaluated in the areas of passenger (light-duty) vehicles, public transit, and freight transport. The energy efficiency of passenger vehicles was evaluated using a comparison of fuel economy standards, the average fuel economy of on-road passenger vehicles, and the total vehicle miles traveled (VMT) per person in a year. The metrics evaluating public transit considered both investment in and use of modes of public transport in a nation. The energy intensity of freight transport was evaluated based on the energy consumed per ton-mile. An additional measure of the efficiency of goods movement was provided by ton-mile per unit GDP, a measure of locational efficiency.

All countries scored low in the transportation sector. The highest-scoring countries (India and Italy) both received 0 points in at least one category. Australia and the United States scored particularly low in this section. The United States received a score of zero in four out of the eight metrics. Most countries had a mandatory fuel economy standard for light-duty vehicles in place and in effect by 2025, but a standard does not necessarily translate into better average fuel economy of on-road light-duty vehicles due to when standards take effect and differences in factors such as vehicle size and driving habits. Similarly, the countries having the highest ratio of spending on rail relative to roads did not have the highest ridership in public transit. Table 36 shows the scores by country for the transportation section and each metric.

Table 36. Transportation sector scores by country

	Total score	Vehicle miles traveled per capita	Fuel economy of light-duty vehicles	Fuel economy standards for light-duty vehicles	Fuel efficiency standards for heavy-duty tractor trucks	Energy intensity of freight transport	Freight transport per unit economic activity	Use of public transit	Investment in rail transit vs. roads
Italy	17	2	3	4	0	1	3	1	3
India	16	3	3	2	0	2	1	3	2
Japan	15	1	2	3	1	1	3	3	1
UK	15	1	3	4	0	1	3	1	2
Brazil	14	2	2	1	0	2	1	3	3
China	14	3	1	1	2	2	0	3	2
France	14	2	2	4	0	1	3	1	1
Spain	14	2	2	4	0	1	2	1	2
EU	13	1	2	4	0	1	2	1	2
Germany	13	1	2	4	0	2	2	1	1
Canada	11	1	1	2	3	2	2	0	0

	Total score	Vehicle miles traveled per capita	Fuel economy of light-duty vehicles	Fuel economy standards for light-duty vehicles	Fuel efficiency standards for heavy-duty tractor trucks	Energy intensity of freight transport	Freight transport per unit economic activity	Use of public transit	Investment in rail transit vs. roads
Russia	11	2	1	0	0	3	0	2	3
Mexico	10	2	1	1	0	0	2	3	1
South Korea	10	1	1	1	0	0	2	3	2
USA	8	0	0	2	3	2	1	0	0
Australia	7	1	0	0	0	3	1	1	1

New in this section

The transportation section has a new metric looking at fuel economy standards in heavy duty vehicles. The new metric is discussed in its section below.

VEHICLE MILES TRAVELED PER CAPITA (3 POINTS)

This metric was scored according to total miles traveled in a year by passenger vehicles 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 1,000 received 3 points; no more than 2,000, 2 points; and no more than 7,000, 1 point. The United States stands out negatively in this metric with an average VMT per person that is more than twice that of most countries and is 30% greater than the next highest country, Australia. India has an exceptionally low VMT per capita, followed by China.

Table 37. Scores for vehicle miles traveled per person by country

	VMT per capita	VKT per capita	Score
India	85	137	3
China	513	826	3
Italy	1,379	2,220	2
Brazil	1,392	2,240	2
Mexico	1,466	2,359	2
Spain	1,662	2,675	2
Russia	1,733	2,789	2
France	1,811	2,914	2
South Korea	2,288	3,682	1
Japan	3,000	4,828	1

	VMT per capita	VKT per capita	Score
EU	3,517	5,660	1
Germany	4,613	7,425	1
UK	4,847	7,800	1
Canada	5,834	9,389	1
Australia	6,368	10,248	1
USA	9,361	15,065	0

Sources: ICCT 2012; Australian Bureau of Statistics 2013 (Australia); OECD 2011 (France and Italy, extrapolated from 11 months of data); Ministerio de Fomento 2012 (Spain); OECD 2011 (UK); FHA 2014 (USA). For Germany, numbers were an ACEEE estimate calculated by using passenger-kilometer data from in-country expert and dividing by assumption of 1.5 passengers per car.
Note: "VKT" means light duty vehicle km travelled

Fuel Economy and Fuel Economy Standards for Light-Duty Vehicles (3 points/4 points)

For the purposes of this metric, fuel economy standards could include limitations on the amount of fuel consumed relative to distance traveled as well as emission limits on carbon dioxide. Countries with requirements equivalent to greater than 60 mpg by 2025 received a full score of 4 points while countries with requirements between 55 mpg and 60 mpg by 2025 received 3 points. Countries with requirements between 45 and 55 received 2 points. Requirements over 35 mpg by 2025 received 1 point.

In addition to scores for standards, a separate score was awarded for performance—the average on-road fuel economy of light-duty (passenger) vehicles. Countries with fuel economies averaging greater than 35 mpg received the full 3 points, while countries with an average between 35 mpg and 31 mpg received 2 points, and countries with an average between 30 mpg and 25 mpg received 1 point.

The good news is that the majority of countries have standards in place. However, many of these standards are relatively new, and the average fuel economy of on-road passenger vehicles could be dramatically improved in many of the nations analyzed. Table 38 lists results and scores for both metrics by country.

Table 38. Scores for fuel economy and fuel economy standards for light-duty vehicles

	Average fuel economy in 2010 (mpg)	Average fuel economy in 2010 (l/100 km)	Score	2025 fuel economy standards	Score
Italy	38	6.1	3	60.6	4
UK	38	6.1	3	60.6	4
France	34	6.9	2	60.6	4
EU	33	7.2	2	60.6	4

	Average fuel economy in 2010 (mpg)	Average fuel economy in 2010 (l/100 km)	Score	2025 fuel economy standards	Score
Spain	32	7.3	2	60.6	4
Germany	32	7.3	2	60.6	4
India	37	6.4	3	51.7	2
Japan	31	7.7	2	55.1	3
Canada	26	9.0	1	49.7	2
Brazil	32	7.3	2	40.9	1
Mexico	30	7.9	1	35.1	1
China	27	8.6	1	37.4	1
USA	21	10.4	0	49.7	2
South Korea	26	9.1	1	39.3	1
Russia	27	8.6	1	n	0
Australia	21	11.1	0	n	0

Sources: ICCT 2012; Australian Bureau of Statistics 2013 (Australia); Odyssee 2014 (EU, France, Germany, Italy, Spain); EPA 2013 (USA).

USE OF PUBLIC TRANSIT (3 POINTS)

Public transit use was measured by dividing the distance traveled by passengers by rail, bus, and coach by the total distance traveled by passengers across all motorized modes of inland travel (excluding motorcycles). Countries with greater than 30% of travel completed by public transit received a full score of 3 points; greater than 20% received 2 points, and greater than 10% received 1 point. There was a wide disparity among countries. China, India, and Mexico, followed by South Korea, Brazil, Japan and Russia, stand out positively, having considerably higher percentages of travel completed by public transit.

Table 39. Scores for use of public transit

	Distance traveled by public transit (% passenger km by public transit modes)	Score
China	72%	3
India	65%	3
Mexico	52%	3
South Korea	40%	3
Brazil	37%	3
Japan	37%	3
Russia	29%	2
Italy	18%	1

	Distance traveled by public transit (% passenger km by public transit modes)	Score
Spain	18%	1
EU	17%	1
France	14%	1
Germany	14%	1
UK	13%	1
Australia	12%	1
Canada	10%	0
USA	10%	0

Sources: OECD 2011; ICCT 2012 (Brazil, Canada, China, EU, India, Japan, Mexico, Russia).

Note: Results are rounded. Canada and United States are both <10%.

Investment in Rail Transit v. Road Transit (3 points)

Countries' investment in public transit was measured as the ratio of government investment in rail versus roads. Investment in all transit modes would have been a superior metric, but these data were not readily available. Interestingly, in the countries analyzed, high government investment in rail as compared to roads does not appear to be correlated with high use of public transit. This seems to support the view that countries must not only make public transit available, but must also address other factors that affect ridership such as population density, vehicle ownership, size of transit network, transit schedule, fares, etc. However, we do see some overlap in investment in rail and energy intensity of freight, such as in Russia (see Table 42). We recognize that in many countries, transit may be primarily funded by local governments; however, regulations at the local level are beyond the scope of this *Scorecard*.

Brazil, Russia, and Italy are the only countries analyzed that invest more money in rail than roads. The rest of the countries analyzed were spending more national government funding on road infrastructure, indicating that their priority is in roads—light- and heavy-duty vehicles rather than rail transit, which is often less energy intensive. Countries with spending in a ratio of 1.00 or greater of rail to roads received the full 3 points, in a ratio of 0.50 to 1.00 received 2 points, and in a ratio of 0.10 to 0.49 received 1 point. Table 40 provides the results and scores for both metrics by country.

Table 40. Scores for investment in rail transit vs. roads

	Investment in rail transit (ratio of $ in rail versus roads)	Score
Brazil	1.28	3
Russia	1.05	3

	Investment in rail transit (ratio of $ in rail versus roads)	Score
Italy	1.01	3
Spain	0.99	2
UK	0.96	2
China	0.93	2
India	0.93	2
South Korea	0.74	2
EU	0.54	2
France	0.40	1
Germany	0.36	1
Australia	0.25	1
Japan	0.16	1
Mexico	0.14	1
Canada	0.05	0
USA	0.04	0

Sources: OECD 2011; KPMG 2009 (China); DOT 2013 (USA). For the EU, data was based on available data for 23 countries, and rail data were based on available data for 22 countries.

ENERGY INTENSITY OF FREIGHT TRANSPORT AND FUEL ECONOMY STANDARDS FOR HEAVY-DUTY TRUCKS (3 POINTS/3 POINTS)

In the first metric, to assess the energy intensity of freight transport we used a metric measuring energy consumed per ton-mile traveled. In the second metric, we calculated the ton-miles of freight transport per dollar of GDP to determine the amount of freight transport per unit of economic activity, which can be considered a measure of location-efficiency of industrial and commercial activity. Russia, Australia, and Canada scored well in the metric for energy efficiency of freight transportation. The European countries, with the exception of Germany, scored low as a whole on energy intensity of freight transport. Table 41 below presents the scoring criteria for each metric, and Table 42 shows the results for both metrics by country.

Table 41. Point allocation for freight metrics

Energy per ton-mile traveled (kBtu/ton-mile)	Score	Ton-mile per dollar of GDP ($)	Score
0.6	3	0.08	3
1.2	2	0.2	2
2	1	1	1

Table 42. Scores for energy intensity of freight transport and freight transport per unit economic activity

	Energy per ton-mile traveled (kBtu/ton-mile)	Energy per tonne-kilometer traveled (MJ/tonne-km)	Score	Ton-mile per dollar of GDP ($)	Tonne-kilometer per dollar of GDP ($)	Score	Total score
Australia	0.4	0.6	3	0.23	0.17	1	4
Canada	0.8	1.3	2	0.17	0.14	2	4
France	1.8	2.8	1	0.06	0.05	3	4
Germany	0.7	1.1	2	0.09	0.09	2	4
Italy	1.6	2.5	1	0.06	0.06	3	4
Japan	1.4	2.2	1	0.04	0.04	3	4
UK	1.7	2.6	1	0.05	0.05	3	4
Brazil	1.0	1.5	2	0.50	0.47	1	3
EU	1.7	2.6	1	0.09	0.01	2	3
India	1.0	1.6	2	0.93	0.86	1	3
Russia	0.5	0.7	3	1.94	1.47	0	3
Spain	1.3	2.1	1	0.10	0.10	2	3
USA	0.9	1.4	2	0.23	0.22	1	3
China	1.0	1.6	2	1.44	1.04	0	2
Mexico	2.3	3.5	0	0.18	0.16	2	2
South Korea	3.1	4.8	0	0.09	0.08	2	2

Sources: OECD 2013a; Odyssee 2014; National Bureau of Statistics of China 2013 (China and Russia); ICCT 2012 (Brazil, India, South Korea).
Note: "MJ" refers to megajoule

For the 2014 edition of the *International Scorecard* we added in fuel efficiency standards for heavy-duty vehicles, which are relatively new policies for most countries but mark an important step toward countries' capturing additional savings in the transportation sector. For purposes of this metric, fuel consumption standards can include limitations on the amount of fuel consumed relative to ton-mile traveled as well as emission limits on carbon dioxide. Countries received the full 3 points for reduction goals of at least 18%, 2 points for 14%, 1 point for 9%, and no points if they did not have a standard in place. Table 43 shows the standards stringency and scores for each country.

Table 43. Scores for fuel efficiency standards for heavy-duty tractor trucks

	Fuel efficiency standards for heavy-duty tractor trucks (% reduction in fuel consumption or carbon dioxide emissions for tractor trucks)	Score
Canada	18%	3
USA	18%	3
China	14%	2
Japan	9%	1
Australia	NA	0
Brazil	NA	0
EU	NA	0
France	NA	0
Germany	NA	0
India	NA	0
Italy	NA	0
Mexico	NA	0
Russia	NA	0
South Korea	NA	0
Spain	NA	0
UK	NA	0

TRANSPORTATION BEST PRACTICES

Italy. Italy was the highest-scoring country due in large part to its advances in passenger-vehicle energy efficiency. Italy has low vehicle miles traveled per capita, high passenger-vehicle fuel economy, progressive light-duty fuel economy standards (following under the EU's mandate). The national government has provided incentives to encourage consumers to replace old vehicles with new, clean vehicles and has invested in a rail network both for high-speed trains and to improve transport of goods. On the freight side, Italy has low freight transport per unit economic activity.

India. India scored well in transportation energy efficiency because of its strong use of public transit and the low number of light-duty vehicle miles traveled per capita. India's National Urban Transport Policy (NUTP) has helped encourage urban transport solutions and encouraged public transit. More than 65% of passenger trips made in India utilize convenient public transit.

China. China scored highly in the transportation sector in large part because of its low VMT, high use of public transit, and high level of investment in rail compared to roads. China's per-capita VMT is low relative to other developed countries, but as the population continues to grow, many predict that private vehicle ownership will drive up VMT per person. However, China has historically had high levels of investment in high-speed rail and subway systems. China's railway system is the world's third largest network, with 6 percent of the world's track length, and carries about 25 percent of the world's traffic (KPMG 2009). It is expected that China will lay about 16,000 km of high-speed rail by 2020. China is also investing heavily in metro and light rail systems, particularly in some of its larger cities. Such policies to promote public transit and freight shipment through rail are helping improve the energy efficiency of its transportation system.

Figure 8. Best practices in the transportation sector

Overall Recommendations

As we mentioned above, in every metric at least one country received full points. This means that it is possible for countries to receive a perfect score. However, no country even approached a perfect score, and most countries receive roughly half of all possible points. There is significant—and in some cases dramatic—room for improvement across all countries analyzed. Moreover, there are great opportunities for nations to learn from one another by emulating best policies, practices, and performance. Table 44 summarizes some of the best outcomes and policies that countries can look to as recommended models for improving their energy efficiency.

Appendix A summarizes the results for each country, highlighting policy areas in which a country is strongest, areas for improvement, and resources for further information.

Table 44. Highest-scoring policies and performances for each metric

Metrics	Results	Country
National efforts		
Change in energy intensity	A reduction of energy intensity of 50% over the last decade	France
Efficiency of thermal power plants	41%	Japan
Mandatory energy savings goals	Commitments to energy savings greater than 1% per year	France, Germany, Spain, and UK
Tax credits and loan programs	Federal tax credits and loan programs, both covering multiple sectors	Canada, EU, France, Germany, Italy, Japan, Russia, South Korea, and United States
Spending on energy efficiency	$49 per person	Italy
Spending on energy efficiency research and development	$5 per person	France
Size of the energy service companies market	0.23% Percentage of GDP	France
Water efficiency policy	A national policy in place for improving water efficiency and conservation	Brazil, Canada, China, EU, France, India, Italy, Japan, South Korea, Spain, and UK
Buildings		
Energy intensity in residential buildings	1.1 Btu per square foot	China
Energy intensity in commercial buildings	2.2 Btu per square foot	India
Residential building codes	Mandatory building codes covering all six categories	Australia, EU, France, Germany, Italy, South Korea, Spain, and UK
Commercial building codes	Mandatory building codes covering all five categories	Australia, EU, France, Germany, Japan, South Korea, Spain, and UK
Building labeling	All buildings subject to energy labeling and rating disclosure	Australia, EU, France, Germany, Italy, Spain, and UK
Appliance and equipment standards	45	United States

Appliance and equipment labeling	Categorical program	Australia, Brazil, China, the EU, France, Germany, India, Italy, Japan, South Korea, and UK
Building retrofit policies	Building retrofit polices in place, either as part of countries' building codes or as a separate policy	France, and Germany
Industry		
Energy intensity of industrial sector	1.35 Btu per dollar industrial GDP	Australia
Industrial electricity generated by CHP	24.1%	Italy
Investment in manufacturing R&D	9.6% of industrial GDP	Japan
Voluntary energy performance agreements with manufacturers	Government partnerships with energy-saving agreements and incentives for a variety of business types	Australia, Canada, EU, France, Germany, Italy, Russia, South Korea, and UK
Mandate for plant energy managers	Requirement for a dedicated, on-site energy expert	China, India, Italy, and Japan
Mandatory energy audits	Requirement for periodic energy audits of facilities	Australia, China, EU, France, Germany, India, Japan, Russia, South Korea, and Spain
Agriculture energy intensity	0.018 Btu per dollar agriculture GDP	India
Transportation		
Vehicle miles traveled per capita	85 vehicle miles traveled per capita	India
Fuel economy of light-duty vehicles	38 mpg for an average on-road passenger vehicle	Italy and UK
Fuel economy standards for light-duty vehicles	2025 fuel economy standard of 60.6 mpg	France, EU, Germany, Italy, Spain, and UK
Fuel efficiency standards for heavy-duty tractor trucks	Mandatory 18% reduction in fuel consumption or carbon dioxide emissions during the rule for heavy-duty trucks and tractor trucks	Canada and United States
Energy intensity of freight transport	0.4 kBtu per ton-mile	Australia
Freight transport per unit economic activity	0.04 ton-miles per dollar GDP	Japan
Use of public transit	72% of motorized passenger kilometers by rail, bus, or coach	China
Investment in rail transit vs. roads	$1.28 invested in rail for each dollar invested in roads	Brazil

Recommendations for Increasing U.S. Energy Efficiency

Across most metrics analyzed, the United States has made limited or little progress toward the goal of using energy more efficiently in recent years. In the *2012 International Scorecard* the United States ranked ninth out of 12 countries evaluated, near the bottom of the pack. Unfortunately, the United States did not perform better in this second edition of the *Scorecard*. Overall, the United States did not move up and was ranked toward the bottom of the pack, 13th out of 16 countries. The overall U.S. score of 42 is less than half of the possible points and 23 points away from the top position, occupied by Germany. Further, the United States currently falls behind Japan, the EU, China, Canada, Australia and India.

In the national efforts section the United States ranked 11 out of 16 countries, behind Australia, China, and Spain, and ahead of South Korea. There are a few metrics in this section where the United States is performing well or in the middle of the pack. The United States received full points for its energy efficiency tax credit and loan programs, has a middle-of-the-pack level of investment in energy efficiency, and has a middle-of-the-pack level of efficiency in thermal power plants. However, the United States is one of only two countries with no national energy-savings plan or national greenhouse gas reduction plan. In addition, since the last *International Scorecard* the United States has seen a drop in its investment in energy efficiency R&D.

The United States performed the best in the buildings section, tying at eighth place with the UK. Compared to the *2012 International Scorecard,* the United States' score in this category did not change much. The United States' EnergyGuide appliance label and ENERGY STAR® labels demonstrate best practices for developing voluntary appliance and equipment standards around the world, but would garner higher points if converted from a continuous to a categorical design. The United States also received credit for residential and commercial building codes in place despite lacking a national mandate, because a large number of states have stringent and technical standards in place. The overall energy intensity of the United States' residential and commercial buildings is high relative to other countries.

There is room to improve in the industrial sector, where the United States ranked 13th. The United States has not yet employed mandatory energy audits or required on-site energy managers at manufacturing sites. The United States also has a relatively low level of CHP compared to other countries evaluated. One area where the United States is performing well is its relatively high level of investment in industrial R&D, second only to Japan.

The lowest-scoring section for the United States is the transportation sector, where the United States ranks second to lowest. The number of vehicle miles traveled (VMT) per person in the United States far exceeds the VMT by people anywhere else in the world, and use of public transit is very low. Current fuel economy standards are the bottom half of the countries with standards in place, and average fuel economy also remains lowest here. The United States should look to other countries that have implemented effective transportation policies to improve its performance in this sector, such as Italy, Japan, or the UK.

The low U.S. scores suggest that these other economically developed countries may have an economic advantage over the United States in that using less energy to produce and transport the same economic output costs less. This raises a critical question: how can the United States

compete in a global economy if it continues to waste more money and energy than other developed economies?

The United States must turn the ship around and move in a direction that ensures that it retains a leadership role in the global economy. Here are potential components of such a sea change.

NATIONAL EFFORTS

- **National energy-savings target.** Congress should pass a national energy-savings target to complement existing state policies and raise the bar for all states. Most of the countries analyzed in this *International Scorecard* have such targets. In the interim, the states without mandatory targets for utility energy savings should adopt such targets.

- **Environmental regulation.** As the Environmental Protection Agency moves forward on its regulation of carbon dioxide from automobiles, power plants, and other emitting sectors, it should develop regulations that maximize cost-effective energy efficiency as a mechanism to reduce pollution.

- **Energy efficiency programs.** Overall investment should be increased by utilities and governments (federal, state, and local) in energy efficiency programs to lower consumers' energy bills and speed the transformation of markets for energy efficiency technologies and services.

- **R&D investment.** Increased investment is needed in R&D in energy efficiency to develop new technologies and practices.

- **Federal and state-level financial incentives.** The federal government should extend and improve federal tax credits and other financial incentives to encourage investment in energy efficiency. States should complement federal efforts, particularly in the areas of loans, loan guarantees, and loan-loss reserves.

- **More efficient electricity generation.** Government policies should be adopted that encourage utilities to retire old, inefficient power plants and ensure that any new power plants will be highly efficient.

- **More efficient power distribution.** Electric grid infrastructure should be modernized to reduce line losses. Utilities should deploy high-efficiency distribution transformers, advanced "smart grid" techniques, and increased utilization of distributed energy sources to reduce transmission and distribution losses.

BUILDINGS

- **Building codes.** The federal government should strengthen national model building codes. National model codes should be updated, and the federal government should provide technical assistance to states implementing and adopting energy efficiency building codes.

- **Appliance standards.** Governments and regulators should follow through on the implementation and enforcement of existing appliance standards, should regularly update standards, and should consider standards on additional products (e.g., pumps).

- **Appliance labels.** The current EnergyGuide appliance label should be switched from a continuous to a categorical, five-star label.

- **Disclosure of energy use before the sale of buildings.** State and local requirements should be implemented that require the disclosure of energy use and costs of residential and commercial buildings before the sale or lease of the property.

- **Federal assistance for building owners.** The federal government should provide assistance for building owners that upgrade their buildings and participate in programs such as ENERGY STAR.

INDUSTRY

- **Energy management systems.** Manufacturers should commit to continual improvement in reducing energy intensity of industrial facilities using Superior Energy Performance (SEP 2014), ISO 50001 (ISO 2011), and other voluntary platforms.

- **Reasonable electricity buy-back rates for CHP.** Governments and regulators should adopt policies that allow CHP systems to obtain reasonable electricity buy-back rates.

- **On-site, expert energy managers.** Industrial and manufacturing facilities should employ energy managers to find cost-effective ways of reducing energy use and energy intensity.

- **Regular energy audits.** Industrial and manufacturing facilities should undergo periodic energy audits.

- **Partnerships between industry and government.** Voluntary energy-saving partnerships between the government and industrial sector should be expanded.

- **Industrial assessment centers.** The federal government should support education and training in the manufacturing and industrial sectors. Government should support the manufacturing and industry sector to reduce the energy intensity of facilities by providing education, outreach, and training that will facilitate greater investment in energy efficiency and quicker adoption of systematic energy management practices.

TRANSPORTATION

- **Fuel economy for light-duty vehicles.** The federal government should determine the maximum feasible improvement for light-duty vehicle fuel economy for 2021-2025 in the upcoming midterm review of the corporate average fuel economy (CAFE) standards, and in particular set standards at least as stringent as the current provisional standards for that period.

- **Fuel efficiency for heavy-duty vehicles.** The federal government should adopt standards for heavy-duty vehicle fuel efficiency that would bring average new-vehicle fuel consumption to 40% or more below 2010 levels in model year 2025.

- **Investment priority.** The U.S. Congress should prioritize energy efficiency in transportation spending. Federal government budgets should apply energy efficiency performance metrics in prioritizing federal transportation investments and increase funding levels for energy-efficient modes of passenger and freight transport.

- **Innovative technologies.** Advances in fuel-efficient technologies should be continued, and investment in R&D for motor vehicles should be increased.

- **Vehicle miles traveled.** The United States should reconsider the pricing of transportation and should facilitate the adoption of policies such as pay-as-you-drive insurance, in which the cost of insurance is determined primarily by the number of miles traveled.

- **Urban development.** Incentives should be created to encourage more compact, transit-oriented development of cities and suburbs.

- **Non-highway modes.** Federal support should be increased for public transit, freight rail, and non-motorized modes of transportation.

- **More efficient modes of freight transport.** Policies should be adopted that increase intermodal freight transport and that shift freight from heavy-duty trucks to rail and waterway transit wherever possible.

Conclusion

This *International Scorecard* has provided a summary of energy efficiency in developed economies across the globe, and here at home the results are disappointing. The United States, once considered an innovative and competitive world leader, has moved slowly, while European countries, Japan, and China have surged ahead. Fortunately, the United States has many opportunities to improve its nationwide energy efficiency, and our comparison of 16 of the world's largest economies provides examples of how the United States can do better. This analysis also revealed that, while some countries are clearly outperforming others, the biggest story is how all of these economies have substantial room for improvement. A highly efficient economy is well within reach of every country analyzed. The highest score in each of the 31 metrics was obtained by at least one, and in most cases more than one, top-performing country. The conditions required for a perfect score of 100 points are thus currently achievable and are in practice, yet the highest score obtained was only 65 points out of 100, and the average score was just 50.

In many areas the United States has failed to improve its efficiency significantly in recent years. More work is needed.

Countries that use energy more efficiently use fewer resources to achieve the same goals, thus reducing costs, preserving valuable natural resources, and gaining a competitive edge over

countries where resources are wasted and costs are higher. The opportunities for improvement in the United States and worldwide are significant, and the need to rise to the challenge is serious. Countries can preserve their resources, address global warming, stabilize their economies, and reduce the costs of their economic output by using energy more efficiently—an eminently achievable goal.

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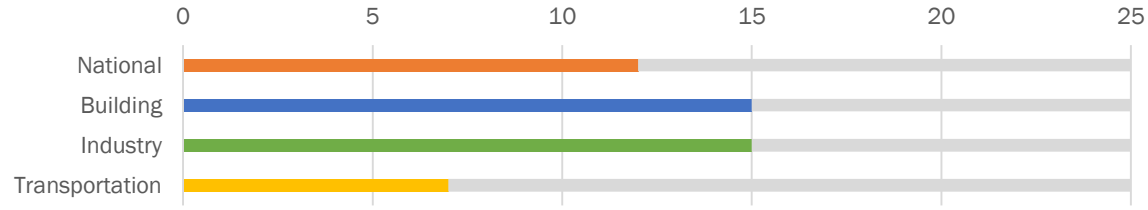
Appendix A: Country Summaries

Appendix A compiles one-page summaries of each country on how they performed in the *Scorecard*. The summaries include where countries are strongest and areas for improvement, with links to places where interested parties can find more information. The United States was not included in these summaries, but a discussion of the United States can be found on pages 60 through 63.

COUNTRY SUMMARY: AUSTRALIA #10



Coming in tenth, Australia ranked higher than the United States and India, and 1 point lower than Canada.

Australia was strongest in building energy efficiency due to its comprehensive building codes, building labeling program, and appliance and equipment labeling program. Starting in 2000, its strategy to reduce greenhouse gases from buildings has included mandatory building energy codes for new buildings—minimum energy-performance requirements. These requirements cover the residential and commercial sectors and include a wide-ranging set of technical elements.

Australia also scored well in industrial efficiency due to a low energy intensity in manufacturing, its various voluntary energy performance agreements with manufacturers, and its incentives for manufacturers. The Australian government recently invested significantly in energy efficiency and has made a major financial commitment through the Climate Change Action Fund to assist the industrial sector and community organizations in the pursuit of improved energy efficiency. However, there has been some recent threats to their industrial energy efficiency. The Australian government introduced several bills to repeal the Clean Energy Future Package, and the outcome of this legislative process will be reflected in future editions of the report.

ADDITIONAL RESOURCES

For more information on Australia's building codes:
https://www.energycodes.gov/sites/default/files/documents/CountryReport_Australia.pdf

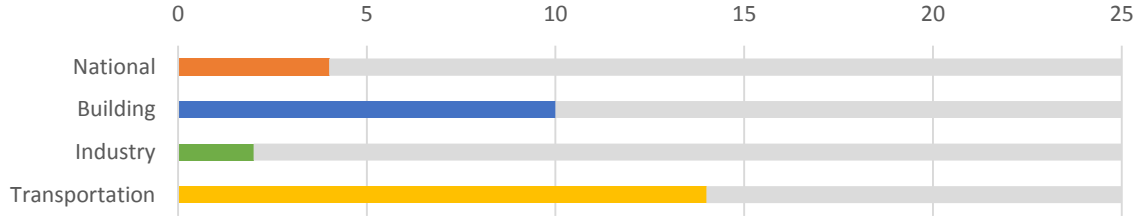
For more information on Australia's energy efficiency policies:
http://www.environment.gov.au/climate-change/emissions-reduction-fund

Areas for Improvement

The Australian government formerly committed to national energy savings goals, but these were never implemented. The current government has made no such commitments, although there exist some state-based savings goals and programs. In addition, several of Australia's energy efficiency grant programs—national policies that can help spur greater efficiency and innovation—have recently expired and have not been replaced. The country has dramatically reduced its investment in efficiency and has rolled back its efficiency incentive programs, causing its score to decline.

Australia was the lowest-scoring country in the transportation sector. Australia does not currently have fuel economy standards for passenger vehicles or for heavy-duty trucks. Standards for vehicles would be beneficial for advancing efficiency in the transportation sector. In addition, Australia has a low percentage of public transit use, a low ratio of investment in rail to investment in roads, and high freight ton-mile per unit of economic activity.

COUNTRY SUMMARY: BRAZIL #15



Brazil ranked 15th with 30 points out of 100. Energy policy in Brazil largely emphasizes renewable energy production, especially in its electricity and transportation sectors. This focus on energy production leaves a great amount of energy efficiency untapped.

Transportation is the most efficient sector in Brazil; Brazil ranked towards the top of the pack of countries analyzed. Passenger-vehicle fuel economy is fairly strong, and the number of vehicle miles traveled per person is moderate. Further, the ratio of government investment in rail transit to investment in roads is the highest in Brazil out of all countries analyzed. The Brazilian National Development Bank has increased funding for the construction of new railway lines and the expansion of the current network to improve freight efficiency. It also plans to build a high-speed rail connecting Sao Paulo and Rio de Janeiro and to improve light-duty (passenger) vehicle fuel-economy.

The Brazilian government established a National Plan on Climate Change (PNMC) that contains some provisions related to the establishment of a national energy efficiency action plan. No national energy savings policy has been implemented, but a proposed national action plan would aim to reduce electricity consumption by 10%, saving up to 106 terra watt hours per year by 2030.

ADDITIONAL RESOURCES

For more information on Brazil's National Climate Change Plan: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Brazil

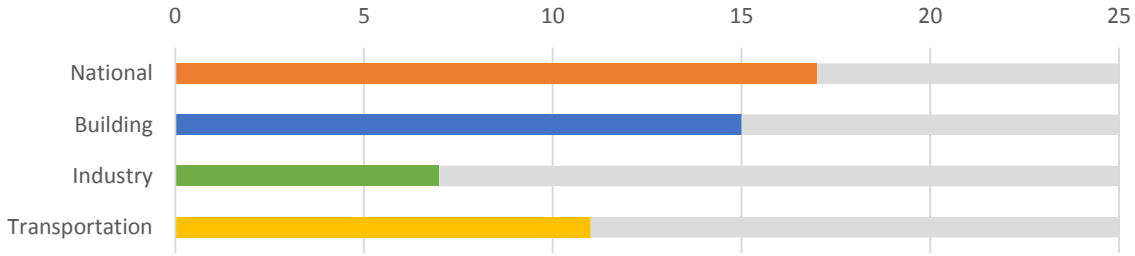
For more information on Brazil's energy efficiency policies: http://www.bndes.gov.br/SiteBNDES/bndes/bndes_en/Institucional/Press/Noticias/2014/20140522_estudo.html

Areas for Improvement

Although Brazil has a low energy intensity in residential and commercial buildings, it still scored at the bottom in the buildings section. Brazil has no mandatory residential or commercial building code and has only limited appliance and equipment standards, applying to few products. Many countries have seen significant energy savings by implementing building energy efficiency policies, including Australia, France, and Spain. The United States has saved large amounts of energy through robust appliance standards. Brazil thus has ample models from which to draw from to improve energy efficiency in buildings.

Brazil scored the lowest of any country analyzed in the industrial sector, and it would benefit from public-private voluntary agreements for energy efficiency and requirements for plant energy managers or periodic energy audits. Less than one percent of electricity in its industrial sector is generated with combined heat and power. Some European countries, most notably, Italy, have achieved strong energy savings by generating industrial electricity from combined heat and power, and Brazil would do well to follow that example.

COUNTRY SUMMARY: CANADA #9



Overall, Canada ranked ninth among the economies analyzed, scoring higher than Australia, India, and the United States.

Canada is strongest in the national efforts category, having energy-savings targets in place and offering incentives and loans for efficiency improvements. In 2008, Canadian provinces and territories committed to achieving a 20% increase in energy efficiency by 2020 through improvements to building codes, broader regulation of energy-consuming products, the establishment of green building policies for new government-funded facilities, support for home energy audits, and retrofit assistance. National tax incentives exist in multiple sectors to help reach efficiency targets, but government investment in energy efficiency remains low, and investment in research and development is only moderate.

Canada also scored well on building energy efficiency due in part to its comprehensive appliance and equipment standards, which cover a large number of products on the market, and its mandatory "EnerGuide" labeling program modeled after the EnergyGuide label in the United States. Canada has taken steps to improve the benchmarking and labeling of energy use in its building through a new benchmarking portfolio manager that marks building energy performance against similar buildings.

ADDITIONAL RESOURCES

For more information on Canada's energy efficiency policies: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Canada

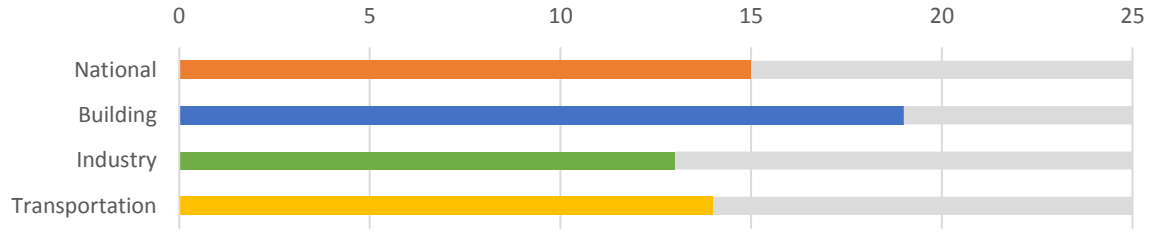
For more information on Canada's energy labeling program: http://www.nrcan.gc.ca/energy/products/energuide/12523

Areas for Improvement

Canada scored low in industrial efficiency and would benefit from establishing a mandate for plant energy managers and mandatory energy audits. Our research indicated that just 1.8% of the electricity consumed by the industrial sector is generated by combined heat and power, and only about 3% of manufacturing GDP is spent on manufacturing research and development. Other countries, most notably Japan, have improved energy savings in this sector with increased investment in industrial research and development and requirements for energy managers and audits.

Canada would also benefit from energy efficiency improvements to its transportation sector. Canada has adopted fuel economy standards for passenger vehicles, but the number of vehicle miles traveled per person is in the top two of all countries analyzed. Further, the use of public transit and national investment in rail transit is low in Canada, and it barely outranks the United States, the lowest-ranked country in the public transit metric.

COUNTRY SUMMARY: CHINA #4



China tied for fourth with France, and ranked significantly higher than the United States for the second time, just behind the EU.

China ranked first in building energy efficiency. Residential buildings consume less energy per square foot than those in any other country analyzed, and commercial buildings have the second lowest energy consumption per square foot. Both residential and commercial buildings in urban areas are subject to mandatory building codes. However, China still has room for improvement in the compliance and enforcement of its building codes, which have been historically stronger at the design stage than the construction stage. China has also adopted appliance and equipment standards for a relatively large number of products and requires energy efficiency labeling for some building types.

China also scored well in transportation efficiency, tied with Brazil, France, and Spain. In addition to its low average passenger-vehicle fuel economy, China has mandatory fuel economy standards for both passenger vehicles and heavy-duty trucks. The number of vehicle miles traveled per person is very low, and the percentage of trips taken by public transit is higher than in any other country. In June 2012, China enacted an energy-savings plan and a new development plan for the auto-industry aimed at producing energy-efficient vehicles. Under the plan, passenger-vehicle fuel consumption is expected to drop, and the country has a target of 5 million plug-in hybrid and electric vehicles by 2020.

ADDITIONAL RESOURCES

For more information on China's building codes:
http://www.energycodes.gov/sites/default/files/documents/CountryReport_China.pdf

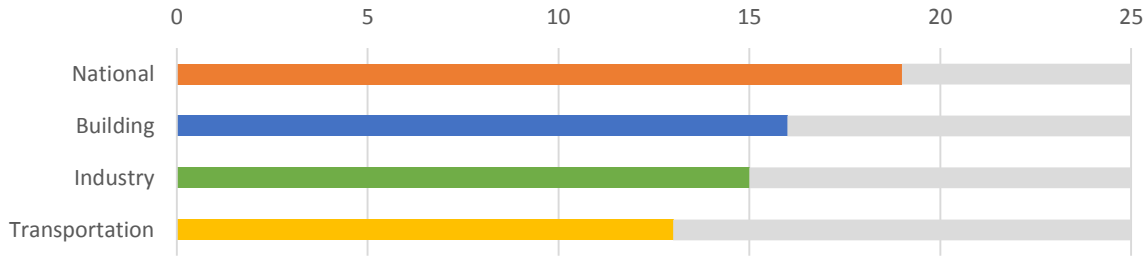
For more information on China's energy efficiency policies:
http://www.iea.org/policiesandmeasures/energyefficiency/?country=China

Areas for Improvement

Even though the Chinese government has developed an array of policies and tax credits or loan programs to support energy efficiency, the country ranked only moderately in comparison to the national efforts of other countries. China's spending on energy efficiency research and development remains low, and the efficiency of thermal power plants and the per-capita investment in energy efficiency is in the middle range of the countries analyzed. Countries or regions such as Japan and the EU have some good examples of national energy efficiency policies that could be emulated.

The energy intensity of China's industrial sector is the second highest of the countries analyzed, and there is little investment in research and development for industrial manufacturing.

COUNTRY SUMMARY: EUROPEAN UNION #3



Coming in third, the EU ranked below Germany and Italy. Although the EU is made up of 28 member countries, in our analysis it was treated in the same way that we treated individual countries because its economy is similar in size to that of the United States.

The EU earned the highest score on its national energy efficiency efforts, tied with France and Italy. In December 2012, the EU's Energy Efficiency Directive (2012/27/EU) entered into force, establish common framework for achieving the EU's goal of cutting primary energy consumption by 20% by 2020. Under this policy, each member state is required to set a national energy efficiency target and achieve a set amount of energy savings between 2014 and 2020. This directive is a great example of leadership at the level of a centralized government that leads to broad implementation by all regions, states, and localities.

The EU improved its ranking in the industrial sector since the first edition of the *International Scorecard*, having adopted policies requiring energy audits and having put in place a requirement for voluntary agreements and government incentives for manufacturers to invest in energy efficiency. Notably, the percentage of electricity consumed by the industrial sector that is generated by combined heat and power is the second highest of the economies surveyed.

Areas for Improvement

Both residential and commercial buildings are subject to mandatory building energy efficiency codes and labeling standards, but energy use per square foot is in the middle of the range of countries analyzed. Fortunately, the improvement of the energy efficiency in buildings is a major focus of the Energy Efficiency Directive and the Energy Performance of Buildings Directive (2010/31/EU).

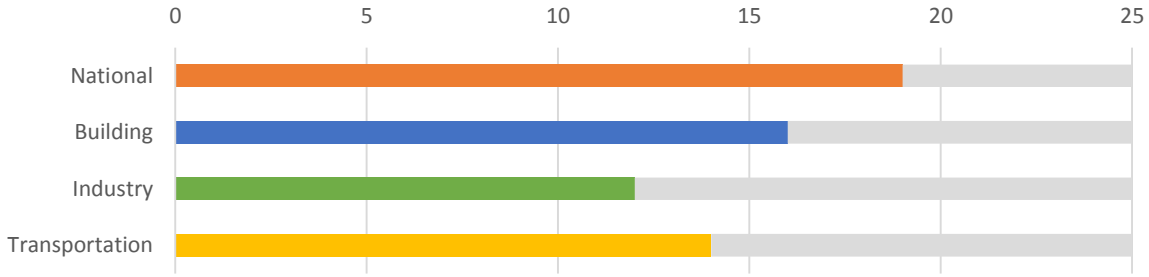
ADDITIONAL RESOURCES

For more information on the EU's energy efficiency policies:
http://ec.europa.eu/energy/efficiency/eed/eed_en.htm

For more information on the EU's building efficiency:
http://ec.europa.eu/energy/efficiency/buildings/buildings_en.htm

The EU transportation sector also ranked in the middle range of the countries analyzed. The vehicle miles traveled per person and average fuel economy of passenger vehicles is lower in Europe than many economically developed countries. To further improve its score in transportation, the EU should implemented fuel efficiency standards for heavy-duty trucks, which would spur greater efficiency in its heavy-duty fleets.

COUNTRY SUMMARY: FRANCE #4



Tying for fourth with China, France scored 61 points, just 2 points away from second place.

France's strongest score was due to its national efforts to promote energy efficiency. France has experienced the greatest decrease in overall energy intensity of all countries analyzed, with a 50% reduction over the last decade. France has made a major commitment under the EU's Energy Efficiency Directive (2012/27/EU) to reduce energy consumption by more than 17% by 2020. France also has the largest energy service companies market of all of the countries analyzed.

In addition France, scored well in building energy efficiency. Residential and commercial buildings in France consume a relatively high amount of energy per square foot, but France has established strong mandatory building codes and a mandatory building labeling program for all buildings. New building codes in France, *Réglementation Thermique 2012* (RT2012), are expected to bring significant improvements to the energy performance of buildings.

ADDITIONAL RESOURCES

For more information on France's national energy efficiency commitment: http://ec.europa.eu/energy/efficiency/eed/doc/reporting/2013/fr_2013report_en.pdf

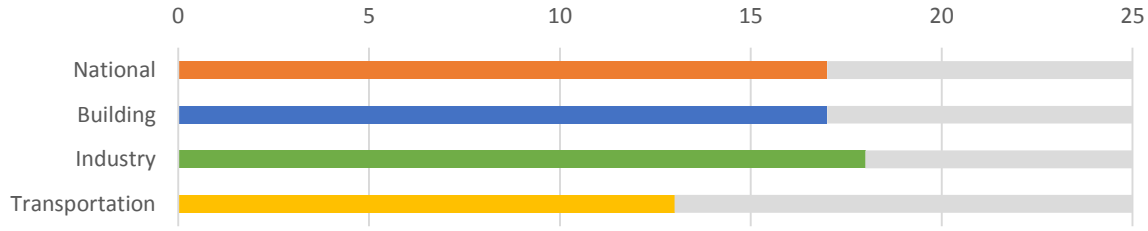
For more information on France's building codes: http://www.sustainablebuildingscentre.org/buildings/codes/France/National/non-residential/new/RT2012

Areas for Improvement

France is a leader in many aspects of the energy efficiency policies and practices of its industrial sector. However, the energy intensity of the sector could be further reduced by requiring industrial facilities to employ energy managers and by increasing the amount of electricity generated by combined heat and power.

The energy intensity of freight transport in France is high, and investment in rail versus roads is low. France would benefit from measures to decrease the energy intensity of freight transport by investing in rail transit and encouraging the use of public transit for passenger travel. Other countries including Brazil and Russia have improved transportation efficiency through similar efforts and offer examples worthy of emulation.

COUNTRY SUMMARY: GERMANY #1



Coming in first overall, Germany ranked the highest of all the countries analyzed. German policy makers have implemented a comprehensive energy strategy, known as *Energiewende,* helping it to achieve one of the most energy-efficient economies. The country has set a target of a 20% reduction in primary energy consumption by 2020 and 50% by 2050, compared to 2008 levels.

Germany has made strong progress and earned a high score in the buildings sector with mandatory codes and a mandatory labeling program for both residential and commercial buildings based on the EU's mandatory Energy Performance in Buildings Directive. The most recent version of EnEv, Germany's performance-based code released in 2013, includes many progressive aspects and supporting policies. As part of its efforts to improve appliance standards, the German government commissioned a project to identify the 100 most important products in terms of energy consumption and established the Climate Angel label program to provide transparency for consumers.

Germany has also shown a strong commitment to energy efficiency in its industrial sector and demonstrates a number of best practices. Industry in Germany has the lowest energy intensity of any country except Australia, and 13% of electricity is generated with combined heat and power. The German government is looking to increase combined heat and power to 25% by 2020, and legislation is forthcoming. In 2013, Germany established a funding program to increase energy efficiency in production processes and provides financing for conversions to energy-efficient technologies in the industrial sector.

ADDITIONAL RESOURCES

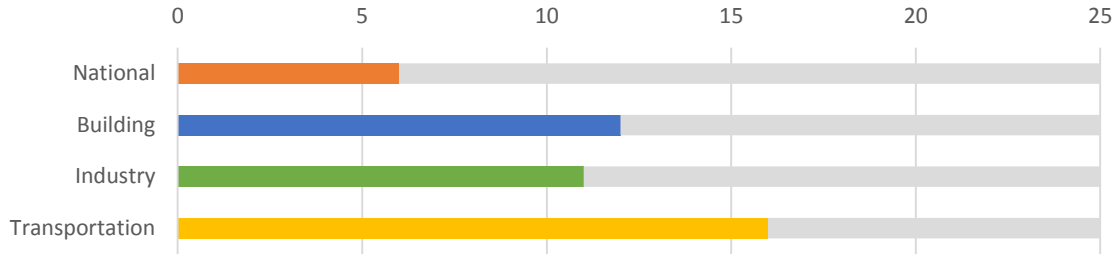
For more information on Germany's energy efficiency policies:
http://www.iea.org/policiesandmeasures/energyefficiency/?country=Germany

For more information on building energy codes in Germany:
http://www.gbpn.org/databases-tools/bc-detail-pages/germany#Summary

Areas for Improvement

Despite being the highest-scoring country in the *International Scorecard*, Germany still has room for improvement and should continue to ensure that it meets its policy commitments to efficiency. Germany ranks fifth in the national efforts category. The country has relatively low investment in energy efficiency research and development compared to other European countries, and Germany would benefit from a greater focus on providing funding to government and utilities for energy efficiency research and development of efficient technologies. Australia offers a good example of leadership in this area with its high spending on energy efficiency research and development. Germany could also look toward innovative financing to help spur the uptake of energy-efficient technologies such as is being done in Japan and South Korea.

COUNTRY SUMMARY: INDIA #11



Coming in 11th, India ranked higher than the United States and South Korea and just four points behind Australia.

India is strongest in transportation energy efficiency. It has a far lower number of passenger miles traveled per capita than any other country analyzed. Even with no fuel economy standards for passenger vehicles, India ranks third in terms of passenger-vehicle fuel economy. More than 65% of passenger trips made in India utilize public transit, with only a moderate level of government investment in rail versus road. Less positively, India has a somewhat inefficient freight system with a high freight ton-mile per unit of economic activity.

India ranked 13th in building efficiency, earning the same score as South Korea. India established its Energy Conservation Building Code for commercial buildings in 2007, which has since been updated and made mandatory by some state governments. India also has building retrofit requirements for saving energy in the commercial buildings sector.

ADDITIONAL RESOURCES

For more information on India's building codes:
http://www.energycodes.gov/sites/default/files/documents/CountryReport_India.pdf

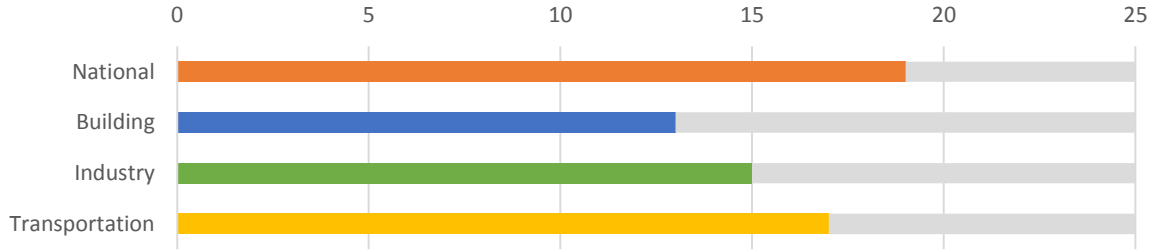
For more information on India's public transportation:
http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/SOUTHASIAEXT/EXTSARREGTOPTRANSPORT/0,,contentMDK:20703625~menuPK:868822~pagePK:34004173~piPK:34003707~theSitePK:579598,00.html

Areas for Improvement

India scored third from the bottom in national efforts on energy efficiency, and there are many opportunities to improve in this category. The operational efficiency of thermal power plants in India is the lowest any country analyzed, largely due to an aging power plant fleet. India would benefit from establishing a mandatory national energy-savings goal and increasing its level of government and utility investment in energy efficiency. Other countries, including France, Spain, and the UK, have achieved substantial efficiency improvements at the national level after committing to an energy-savings goal.

There is also room to improve in India's buildings sector. While energy use per square foot in commercial buildings is lower than in any other country, India's voluntary building energy codes for both residential and commercial buildings could be strengthened. Further, India has appliance and equipment standards for just four products, and its efficiency in the buildings sector could improve significantly by expanding its efforts in this area.

COUNTRY SUMMARY: ITALY #2



Coming in second, Italy scored 64 out of 100 possible points, one point behind the winning country, Germany.

Italy's transportation sector ranked the highest of all countries analyzed. Many countries have adopted stringent fuel economy standards for passenger vehicles, but only Italy and the UK have achieved the high level performance of 38.4 miles per gallon fuel economy for on-road passenger vehicles, which it sets them apart. Vehicle miles traveled per capita is also lower in Italy than any other European country, and Italy has a high ratio of investment in rail transit to investment in roads.

Italy is committed to a national energy-savings target under the EU's Energy Efficiency Directive (2012/27/EU) to reduce energy consumption by 15 megatonnes of oil equivalent by 2020. Several initiatives to support this goal exist at the national level, including a new incentive program, Conto Termico, to provide incentives for retrofits and energy efficiency improvements in residential and public buildings.

Italy has also shown a commitment to energy efficiency in its industrial sector, with energy efficiency policies including voluntary performance agreements, mandates for energy plant managers, and mandates for periodic energy audits. Additionally, the percentage of industrial energy generated by combined heat and power is higher in Italy than any other country.

ADDITIONAL RESOURCES

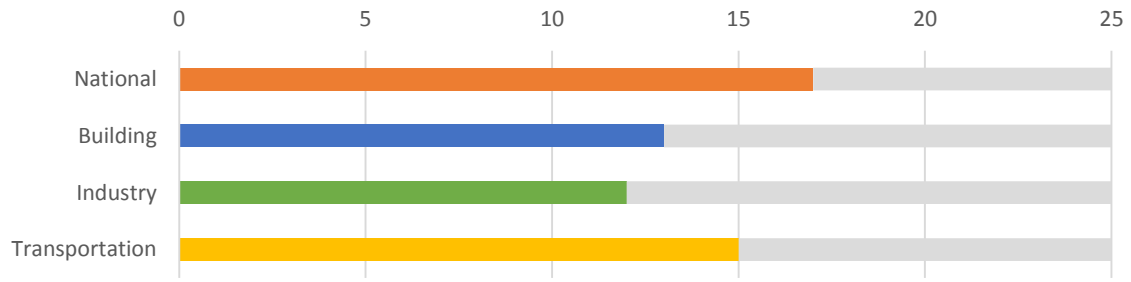
For more information on Italy's recent national energy efficiency policies: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Italy

For more information on Italy's energy efficiency policies: http://www.odyssee-mure.eu/publications/profiles/italy-efficiency-trends.pdf

Areas for Improvement

The greatest area for improvement in Italy is in the buildings sector. While residential buildings in Italy consume a similar amount of energy per square foot compared to Italy's European counterparts, commercial buildings in Italy consume more energy per square foot than any other country in this analysis. Both residential and commercial buildings are subject to mandatory building codes, but Italy would benefit from establishing a mandatory building labeling program and extending appliance and equipment standards to a greater number of products. Best-practice policies for improving efficiency in buildings are demonstrated by countries such as Germany and Australia.

COUNTRY SUMMARY: JAPAN #6



Coming in sixth, Japan scored 57 out of the possibly 100 points, maintaining a strong lead over the United States but falling below the top tier.

Japan tied for fifth in national efforts to promote energy efficiency. Japan has a mandatory energy savings goal, and the national government is currently committing more spending on energy efficiency measures in proportion to its GDP than any other country analyzed. Japan continues to have the highest efficiency of electricity production from thermal power plants in this analysis.

Japan scored well in the transportation category, tying with the UK. Japan has set the highest fuel economy standards for passenger vehicles, at 55 miles per gallon by 2025, although average on-road fuel economy has thus far reached just 31 miles per gallon. Japan is one of only four countries with established fuel efficiency standards for heavy-duty trucks. Even though the ratio of government investment in rail to investment in roads is low, a noteworthy number of passenger trips are made with public transit.

Areas for Improvement

The greatest area for improvement in Japan is in the buildings sector. While residential buildings consume less energy per square foot than in most nations analyzed, commercial buildings in Japan consume much more energy per square foot than all other countries except Italy. Japan has a great opportunity to increase the energy efficiency performance of its buildings by strengthening building codes, improving code compliance, and implementing mandatory building labeling programs for all buildings.

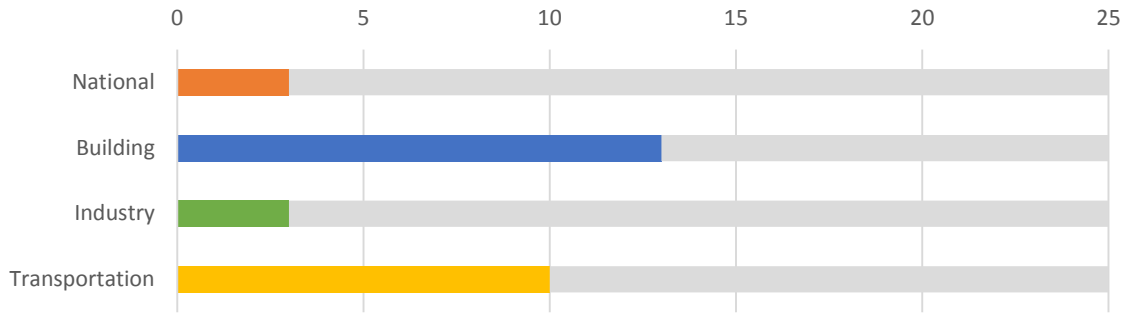
ADDITIONAL RESOURCES

For more information on Japan's light-duty fuel economy standards: http://www.transportpolicy.net/index.php?title=Japan:_Light-duty:_Fuel_Economy

For more information on Japan's energy efficiency policies: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Japan

Japan ranked well on industrial energy efficiency, and its commitment to efficiency in its industrial sector is strong. However, Japan has a very low percent of CHP in its power capacity. Japan has a relatively high level of energy intensity in industry both of which may be improved by the Top Runner Standards for Construction Material policy they have implemented recently.

COUNTRY SUMMARY: MEXICO #16



Mexico ranked last with 29 points, below Brazil and Russia, which came in second and third to last, respectively.

Of the four categories, Mexico is strongest on energy efficiency in buildings, tied with Japan and Italy in 10th place. Energy consumption per square foot in Mexico in both residential and commercial buildings is the lowest of all countries analyzed, and it has mandatory commercial building codes. Mexico has also established appliance and equipment standards for approximately 28 products.

Mexico has made some progress in transportation, with a moderate average fuel economy for passenger vehicles and strong use of public transit. Less positively, the energy intensity of freight transport is second highest of the countries analyzed, and the government has a low ratio of annual federal spending on rail to spending on roads.

Areas for Improvement

Mexico would benefit from establishing a mandatory national energy-savings goal and increasing its level of spending for energy efficiency measures and energy efficiency research and development. Many countries have seen savings from national policies to help spur greater efficiency and innovation, including France, Spain, and the UK, and their initiatives can provide a framework for others.

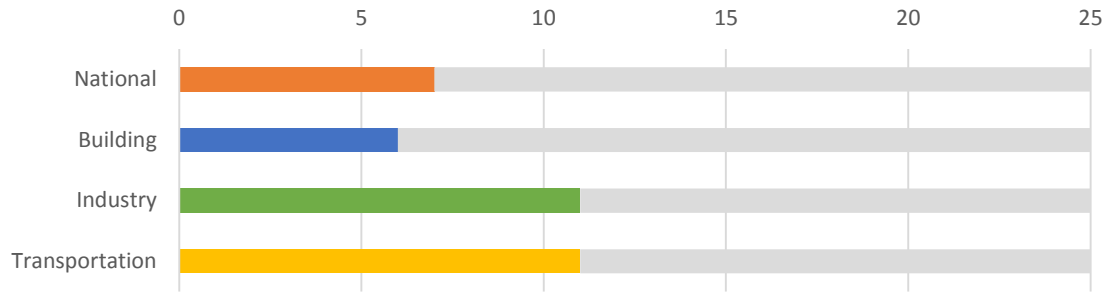
ADDITIONAL RESOURCES

For more information on Mexico's energy efficiency policies and measures: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Mexico

For more information on Mexico's building codes: http://energycodesocean.org/state-country/mexico

There is also room for improvement in Mexico's industrial sector. Mexico and Brazil are the only two countries analyzed without voluntary energy performance agreements or incentives for businesses in the manufacturing sector to improve energy efficiency. Mexico has no law or regulation requiring industrial facilities to employ a plant energy manager, and it does not require periodic energy audits. Mexico could follow the examples of several countries, including India, Japan, and China, which have increased industrial efficiency by establishing these types of policies.

COUNTRY SUMMARY: RUSSIA #14



Coming in 14th, Russia ranked third to last, scoring higher than only Mexico and Brazil.

Of the four categories, Russia is strongest on industrial efficiency, ranking 10th. The energy intensity of Russia's industrial sector is moderately high, but a significant portion of the electricity consumed by the industrial sector is generated by combined heat and power, which improves overall efficiency. Russia does require periodic energy audits of its manufacturing facilities and has agreements and incentives in place between governments and businesses to encourage and promote energy efficiency.

Russia's transportation sector ranked higher than several countries including the United States, Australia, and South Korea. The lower overall energy intensity in Russia's transportation sector is due to fewer vehicle miles traveled per capita and Russia's strong investment in rail transit. This investment in rail brings energy efficiency benefits in the form of low energy intensity of freight transport, of which Russia has the lowest energy intensity of any country analyzed.

ADDITIONAL RESOURCES

For more information on Russia's national energy strategy: http://www.energystrategy.ru/projects/docs/ES-2030_(Eng).pdf

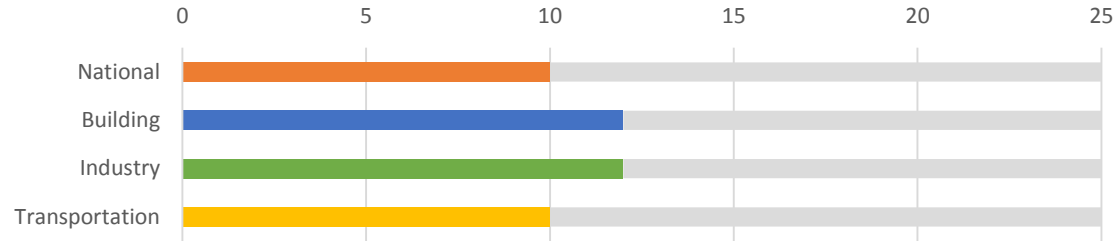
For more information on Russia's energy efficiency policies: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Russia

Areas for Improvement

In the buildings sector, Russia ranked the lowest of all countries analyzed. The energy intensity of residential buildings in Russia is one of the highest of all countries analyzed. Even though building energy codes are mandatory for both residential and commercial buildings, these policies are too weak to stimulate large savings. Furthermore, appliance and equipment standards apply to only one product, the fewest number of products regulated in our study. To increase its efficiency in buildings, Russia would benefit from best practices demonstrated in countries such as Australia, France, and Germany.

There is also room for Russia to improve its national efforts. Thermal power plants in Russia are among the least efficient of any country, and improved federal programs for increasing investment in energy savings would help achieve greater efficiency overall.

COUNTRY SUMMARY: SOUTH KOREA #12



Coming in 12th, South Korea outperformed the United States, Russia, Brazil and Mexico.

Of the four categories, South Korea scored well in the industrial category, tying for sixth with France, Japan, and Spain. The Korean Energy Management Corporation, which implements energy efficiency programs in South Korea, provides financial support and tax credits for businesses that enter into voluntary agreements or invest in energy-saving technologies. In addition, the country requires mandatory energy audits at large manufacturing facilities every five years, and facilities in South Korea generate a fair amount of industrial electricity from combined heat and power, all of which help to lower overall energy use in the sector.

Building efficiency in South Korea scored in the lower range of countries analyzed, tied with India. However, mandatory residential and commercial building codes cover a broad range of technical components, and these codes are stronger in South Korea than in several other countries, including India, Canada and China. Notably, in 2012 South Korea implemented energy efficiency policies for windows that were mandatory, whereas most policies for building components in other countries are voluntary.

Areas for Improvement

South Korea would benefit by improving its national efforts and by increasing the efficiency of its transportation system. The energy intensity of freight transport is highest in South Korea out of all countries analyzed. South Korea can look to other countries such as Italy and Germany that have improved efficiency in transportation through aggressive policies.

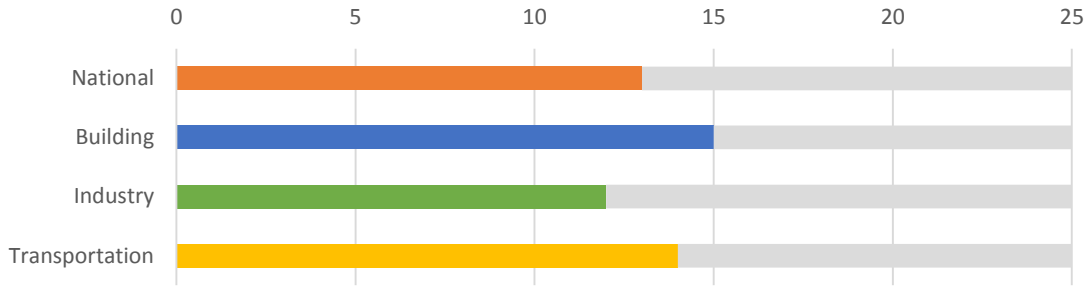
ADDITIONAL RESOURCES

For more information on the South Korea's national energy strategy: http://www.iea.org/Textbase/npsum/Korea2012SUM.pdf

For more information on South Korea's building energy efficiency policies: http://www.pnl.gov/main/publications/external/technical_reports/PNNL-17851.pdf

In terms of national efforts, South Korea's First National Energy Master Plan established a goal of a 47% reduction in energy intensity by 2030, and it implemented various regulations including a plan for an emissions-trading system and for zero-energy buildings. Updated goals have been developed and were implemented with the passing of South Korea's Second National Energy Master Plan in January 2014, which will be reflected in future iterations of the *International Scorecard*. While some policies have already been established, a more coordinated strategy with a focus on energy efficiency would improve these policies under the second plan.

COUNTRY SUMMARY: SPAIN #8



Coming in eighth, Spain ranked lower than all other European countries analyzed.

Spain tied for 5th in the buildings category, tied with Australia and Canada, Spain has strong mandatory building codes for both residential and commercial buildings that cover a broad range of technical elements. Spain is also one of just a handful of countries with a mandatory program for building labeling and building energy disclosure.

Spain scored in the middle of the pack in the national efforts category, in 9th place. Thermal power plants in Spain have the second-highest efficiency of the countries analyzed. Spain's mandatory energy savings goal under the EU Energy Efficiency Directive (2012/27/EU) has a target of 20% energy savings by 2020. The Institute for the Diversification and Saving of Energy (IDEA), the national agency in charge of promoting energy efficiency in the country, is implementing this national objective with a focus on improving final energy intensity by 2% each year from 2010 to 2020. Through this objective and its supporting policies, Spain has experienced success in its national efforts.

Areas for Improvement

The industrial sector in Spain scored well, tying with several other countries but not scoring as high as it did in other sectors. Some elements of Action Plan 2011-2020 are expected to improve industrial efficiency. For example, the plan includes specific aims to install 3,750 megawatts of new combined heat and power capacity and includes a sector-specific energy-savings goal.

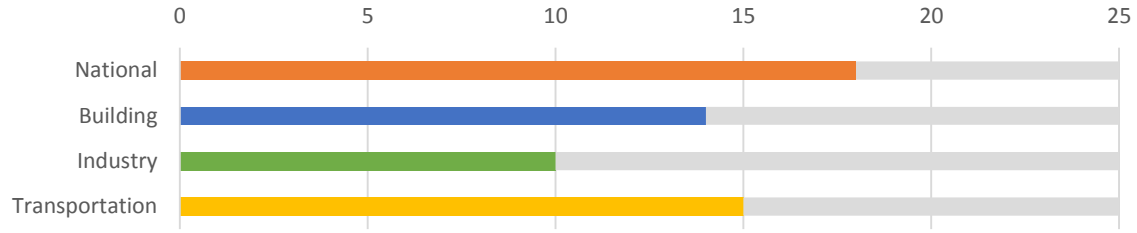
Spain has room for improvement in transportation. Spain scored high compared to other countries analyzed in this *Scorecard,* but could improve its energy intensity of freight transport and implement policies to spur greater use of public transportation. Spain can look to policies in other European countries such as Italy and Germany that have helped to reduce vehicle miles traveled, increase average fuel economy, and encourage the use of public transportation.

ADDITIONAL RESOURCES

For more information on Spain's energy efficiency policies and measures: http://www.iea.org/policiesandmeasures/energyefficiency/?country=Spain

For more information on Spain's Action Plan 2011–2020: http://www.idae.es/uploads/documentos/documentos_11905_PAEE_2011_2020._Executive_Summary_AP._A2011_2a1f1f92.pdf

COUNTRY SUMMARY: UNITED KINGDOM #6



Tying for sixth this year, the UK lost the top spot it had earned in the 2012 *International Scorecard,* falling below the winning country, Germany, by 8 points.

The UK has made great strides in the energy efficiency of its transportation sector, and policies are in place to provide incentives to both businesses and consumers to improve efficiency of transport. For example, some policies reward more efficient freight transport by providing grants to support a shift away from roads and toward rail, while other policies provide consumer incentives to encourage the use of alternative-fuel vehicles. The government plans to invest more than £70 billion in transport by 2021, including plans to build High Speed 2 (HS2), a high-speed railway.

The UK has also made commitments to energy reduction through its national policies, and it scored well in this category. The UK has set its energy efficiency target under the EU Energy Efficiency Directive (2102/27/EU), which would amount to an 18% reduction (of 28.5 megatonnes of oil equivalent) from the UK's 2007 business-as-usual project projection for 2020.

ADDITIONAL RESOURCES

For more information on the UK's energy efficiency policies and measures: http://www.iea.org/policiesandmeasures/energyefficiency/?country=United%20Kingdom

For more information on the UK's financing tool, Green Deal: https://www.gov.uk/government/policies/helping-households-to-cut-their-energy-bills/supporting-pages/green-deal

Areas for Improvement

Energy consumption per square foot of residential building space is relatively high in the UK. Mandatory residential and commercial building codes apply in the UK, but updating its aging building infrastructure at the time of retrofit would greatly improve its buildings' efficiency. Some policies and measures have been put in place to improve building efficiency, but many have been rolled back or reduced since 2012. In addition, the "Green Deal," which provides financing for energy efficiency improvements to homes and businesses, has been publically criticized for being less effective than expected.

The UK ranked low in the industrial sector, in 12th. There are a number of policies that can be put in place, such as requiring periodic energy audits and mandating on-site energy managers in manufacturing plants, that would help boost industrial efficiency in the UK. Other European countries such as Germany and Italy have implemented several policies to reduce the energy intensity of the industrial sector that may serve as model for UK policy development.