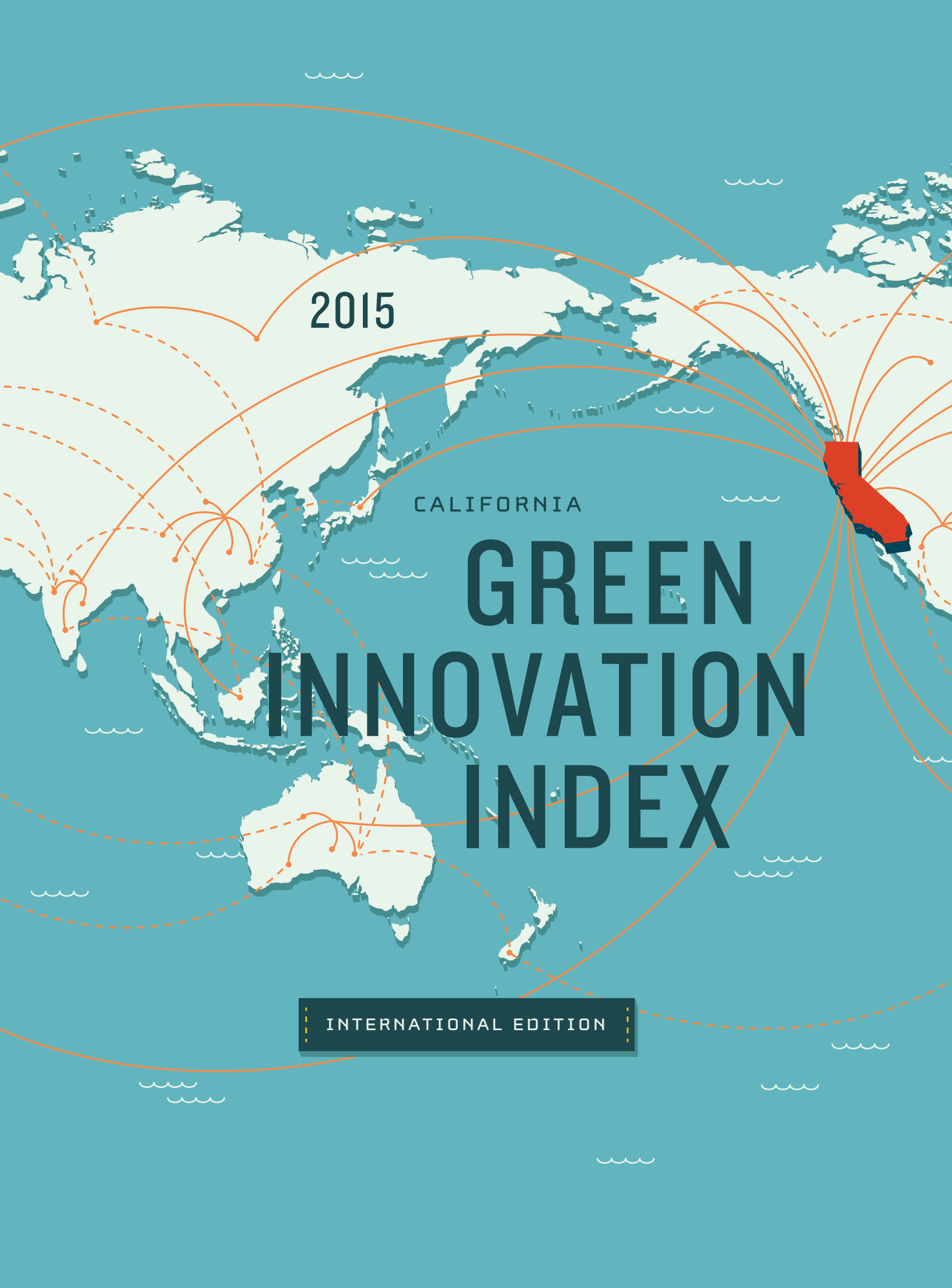
2015
CALIFORNIA
GREEN
INNOVATION
INDEX
INTERNATIONAL EDITION

NEXT 10'S *CALIFORNIA GREEN INNOVATION INDEX* TRACKS THE STATE'S PROGRESS IN REDUCING GREENHOUSE GAS EMISSIONS, GENERATING TECHNOLOGICAL AND BUSINESS INNOVATION, AND GROWING BUSINESSES AND JOBS THAT ENABLE THE TRANSITION TO A MORE RESOURCE-EFFICIENT ECONOMY. AS NATIONS PREPARE FOR GLOBAL CLIMATE NEGOTIATIONS LATER THIS YEAR IN PARIS, THE 2015 INDEX HAS EXPANDED ITS SCOPE INTERNATIONALLY TO COMPARE CALIFORNIA'S PROGRESS TO THAT OF COUNTRIES.

FOUNDED IN 2003 BY BUSINESSMAN AND PHILANTHROPIST F. NOEL PERRY, NEXT 10 IS AN INDEPENDENT NONPARTISAN ORGANIZATION THAT EDUCATES, ENGAGES, AND EMPOWERS CALIFORNIANS TO IMPROVE THE STATE'S FUTURE.

FOR MORE INFORMATION ABOUT THE *CALIFORNIA GREEN INNOVATION INDEX*, PLEASE VISIT WWW.NEXT10.ORG.

WWW.NEXT10.ORG

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COUNTRIES IN THE *CALIFORNIA GREEN INNOVATION INDEX: INTERNATIONAL EDITION*

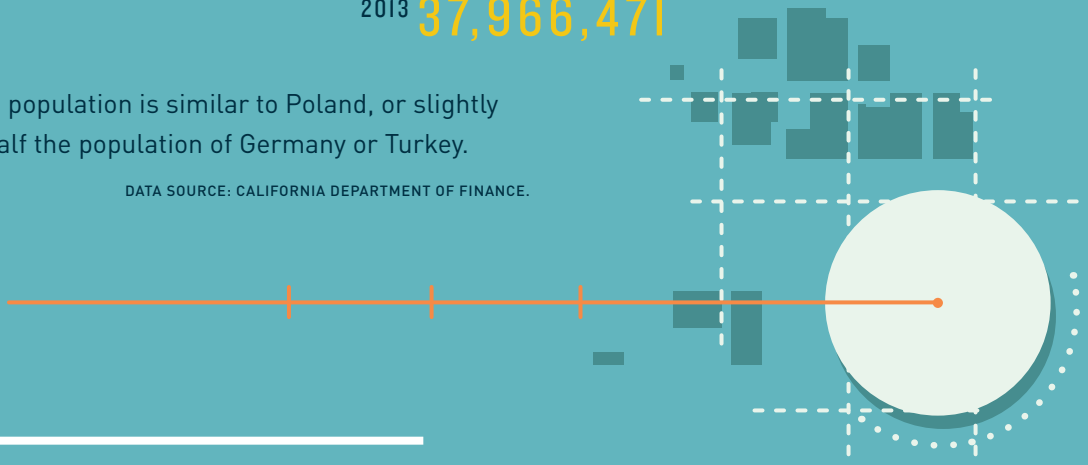
This *International Edition* of the Index focuses on the 50 countries that emit the most energy-related greenhouse gas (GHG) emissions. The energy-related charts primarily include the top five emitters (China, United States, European Union, India, and Russia), plus California. Brazil is also added to many of the charts because its economy is a similar size to California, and other countries of interest are added where possible. Rankings throughout the report are among the top 50 emitters, unless otherwise stated. Rankings most often include the top 10 regions, and add California, the U.S., and China specifically if not already included in the top 10.

CALIFORNIA POPULATION

2013 37,966,471

California's population is similar to Poland, or slightly less than half the population of Germany or Turkey.

DATA SOURCE: CALIFORNIA DEPARTMENT OF FINANCE.



GLOBAL POPULATION SUMMARY

POPULATION IN 2013

GLOBAL RANK	REGION	POPULATION IN MILLIONS
1	CHINA	1,350
2	INDIA	1,221
3	EUROPEAN UNION	510
4	U.S. (WITH CALIFORNIA)	316
5	INDONESIA	251
6	BRAZIL	201
7	PAKISTAN	193
8	NIGERIA	173
9	BANGLADESH	164
10	RUSSIA	143
36	CALIFORNIA	38

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
DATA SOURCE: USDA ECONOMIC RESEARCH SERVICE.
ANALYSIS: COLLABORATIVE ECONOMICS.

CALIFORNIA

GROSS DOMESTIC PRODUCT

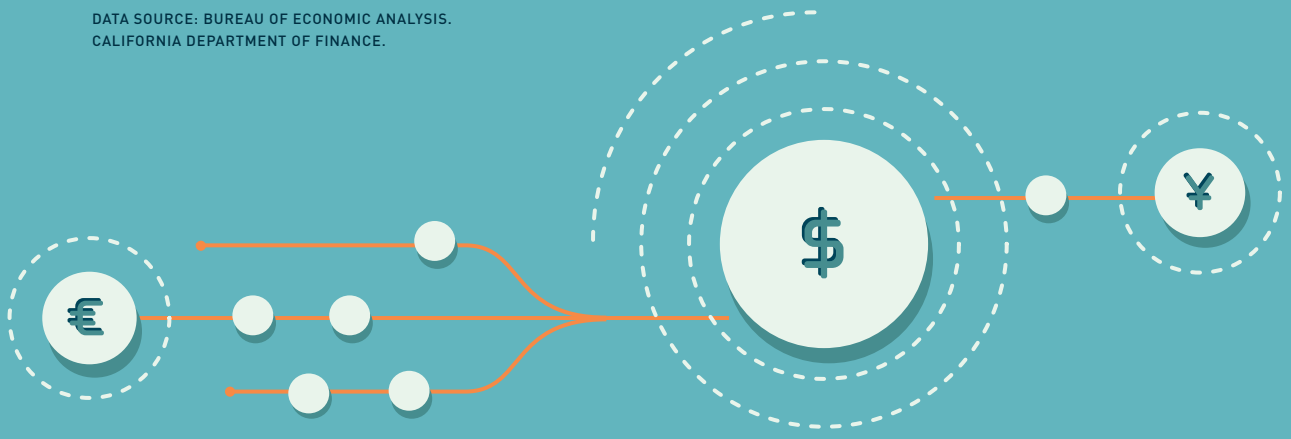
IN 2013 DOLLARS

TOTAL GDP, 2013 **$2.2 TRILLION**

PER CAPITA GDP, 2013 **$58,016**

California's economy is similar in size to Italy or Brazil.

DATA SOURCE: BUREAU OF ECONOMIC ANALYSIS.
CALIFORNIA DEPARTMENT OF FINANCE.



GLOBAL ECONOMY SUMMARY

ECONOMY IN 2013

GLOBAL RANK	REGION	GDP IN TRILLIONS OF CURRENT US$	REGION	GDP PPP* IN CURRENT INTERNATIONAL$
1	EUROPEAN UNION	$ 18.0	EUROPEAN UNION	$ 18.0
2	U.S. (WITH CALIFORNIA)	$ 16.8	U.S. (WITH CALIFORNIA)	$ 16.8
3	CHINA	$ 9.2	CHINA	$ 16.2
4	JAPAN	$ 4.9	INDIA	$ 6.8
5	GERMANY	$ 3.7	JAPAN	$ 4.6
6	FRANCE	$ 2.8	GERMANY	$ 3.6
7	UNITED KINGDOM	$ 2.7	RUSSIA	$ 3.5
8	BRAZIL	$ 2.2	BRAZIL	$ 3.0
8	CALIFORNIA	$ 2.2		
9	ITALY	$ 2.1	FRANCE	$ 2.5
10	RUSSIA	$ 2.1	UNITED KINGDOM	$ 2.5

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. DATA SOURCE: WORLD BANK. ANALYSIS: COLLABORATIVE ECONOMICS.
*PURCHASING POWER PARITY (PPP)

Gross Domestic Product (GDP) is a way of measuring the size of an economy, and is calculated by summing the value added from all industries in the economy. GDP that is converted to a common currency (such as U.S. dollars) uses the market exchange rate. In contrast, GDP that is adjusted using the purchasing power parity (PPP) exchange rate adjusts for the relative price of goods in each country, and generally gives more weight to poorer countries. Though PPP is important to consider, this report uses GDP in U.S. dollars because it is a more common metric.

CALIFORNIA EMISSIONS
(MILLION $MTCO_2e$)

TOTAL GHG EMISSIONS

1990 431 2012 458.7

AB 32 TARGET TOTAL GHG EMISSIONS

2020 431

EXECUTIVE ORDER TARGET TOTAL GHG EMISSIONS

2050 86

DATA SOURCE: CALIFORNIA AIR RESOURCES BOARD.

CALIFORNIA'S GREENHOUSE GAS EMISSIONS

Total GHG emissions include more than the energy-related emissions reported elsewhere in this report. Total emissions include GHG emissions from fossil fuels, electric imports and international fuels, and emissions from sources such as agriculture and waste. Energy-related emissions are from the consumption of petroleum, natural gas, coal, and also from natural gas flaring.

ASSEMBLY BILL 32 (AB 32)

The "California Global Warming Solutions Act of 2006," AB 32 has reinforced California's place at the forefront of climate change policy by requiring the state to reduce its GHG emissions to 1990 levels by 2020. The law builds off of decades of California leadership in energy efficiency and renewable energy polices.

GLOBAL EMISSIONS

TOTAL GLOBAL GHG EMISSIONS FROM ENERGY CONSUMPTION (MILLION $MTCO_2e$)

1990 21,610

2012 32,723

CHANGE FROM 1990

1990–2012 51%

PER CAPITA GHG EMISSIONS

(2012) 4.7

IPCC RECOMMENDED GLOBAL GOAL OF REDUCING EMISSIONS 40–70% BELOW 2010 LEVELS BY 2050 TO MAINTAIN WARMING BELOW 2°C: TOTAL GLOBAL GHG EMISSIONS (MILLION $MTCO_2e$)

2010 31,059

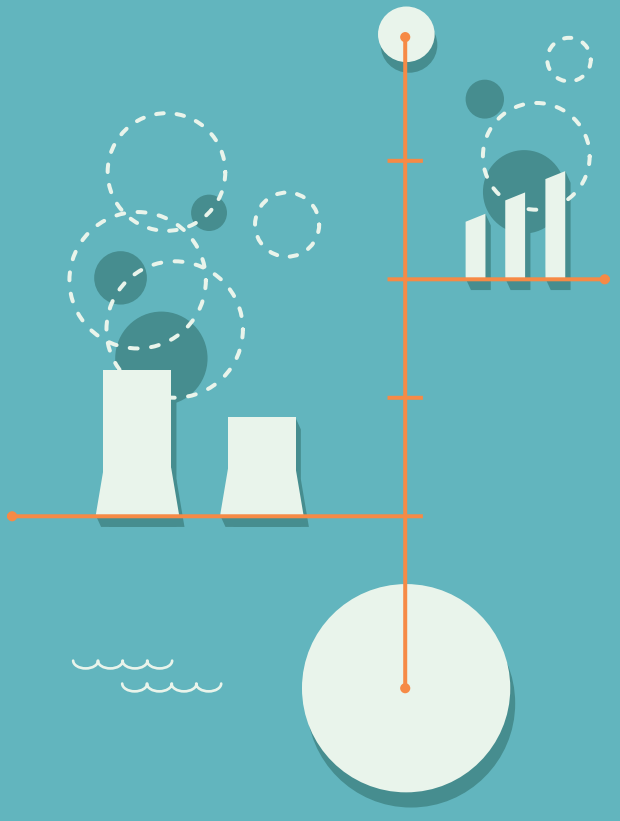
2050 9,300–18,600

DATA SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION, INTERNATIONAL ENERGY STATISTICS.
ANALYSIS: COLLABORATIVE ECONOMICS.

TOTAL GHG EMISSIONS
from energy consumption

GLOBAL RANK	REGION	MILLION $MTCO_2e$
1	CHINA	8,547.7
2	U.S. (WITH CALIFORNIA)	5,270.4
3	EU-28	3,796.9
4	INDIA	1,830.9
5	RUSSIA	1,781.7
6	JAPAN	1,259.1
7	GERMANY	788.3
8	SOUTH KOREA	657.1
9	IRAN	603.6
10	SAUDI ARABIA	582.7

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
DATA SOURCE: U.S. ENERGY INFORMATION ADMINISTRATION.
ANALYSIS: COLLABORATIVE ECONOMICS.



MAY 2015

DEAR GLOBAL CITIZENS,

As the world prepares for negotiations in Paris later this year to set new climate change goals, I eagerly present Next 10's seventh edition of the *California Green Innovation Index, International Edition*. For the first time, we track California's economic and environmental progress in a broader context, examining key economic and climate-related indicators of the world's top 50 greenhouse gas (GHG) emitters.

Carbon emissions from power plants, electricity use, and cars and trucks leveled off in 2014, even as the world's economy expanded — a benchmark in our global efforts to address climate change. Data in the 2015 Index demonstrates how and why in California — and worldwide — economic activity is becoming less dependent on burning fossil fuels.

Of the top 50 worldwide emitters, California ranks as a global leader when it comes to low-carbon intensity, energy productivity (a measurement of GDP relative to total energy consumption), renewable energy, electric vehicle adoption, and clean technology venture capital investment. In fact, among the world's top 50 GHG emitters, California is the second least carbon-intensive economy in the world — only France emits less carbon per dollar of goods and services produced. California is continuing to strive for improvement, and in April 2015, Governor Brown set an executive order target of reducing GHG emissions 40 percent below 1990 levels by 2030.

California's strategic efforts to improve the economy while reducing emissions have shown climate action is possible while also achieving economic growth. Also contributing to our progress — California has secured a number of direct agreements with countries like China, Peru, Mexico, and Israel, as well as states and regions across the world. In addition, California has linked its cap-and-trade system with Quebec, and announced plans to link to Ontario's upcoming system. These partnerships create opportunities for collaboration and action to limit emissions; develop, invest in, and adopt new clean technologies; and foster economic development.

Other regions and countries are also providing leadership and making progress to address climate change. Denmark, for example, generates about half of its electricity from renewable energy. The European Union recently announced its climate goal for the Paris negotiations of reducing emissions 40 percent below 1990 levels by 2030. In addition, the United States and China announced an agreement in 2014 for China to peak emissions around 2030 and the United States to reduce 26-28 percent below 2005 levels by 2025.

Although significant strides are being made to address our climate and energy challenges, much more needs to be done to slow global greenhouse gas production. As delegates from around the world gather for the United Nations Framework Convention on Climate Change, we hope that they will draw on California's history of environmental stewardship and economic growth.

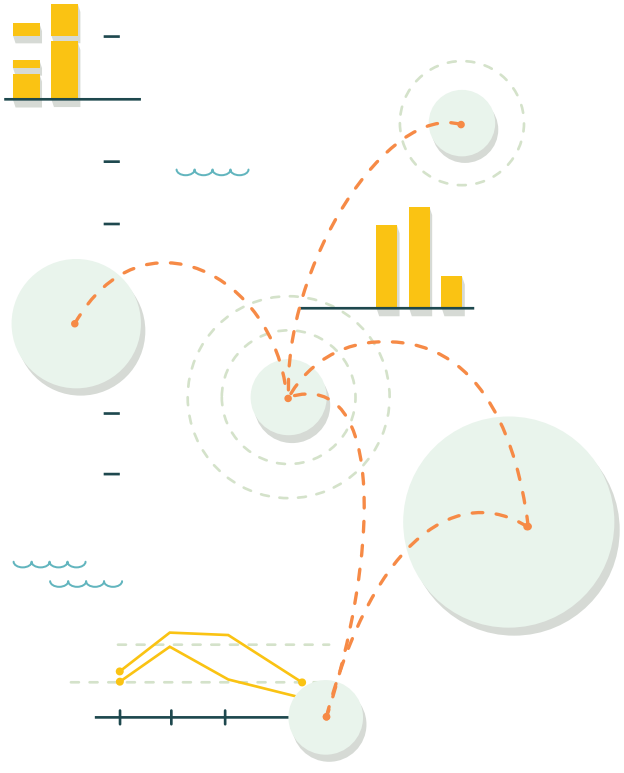
Sincerely,

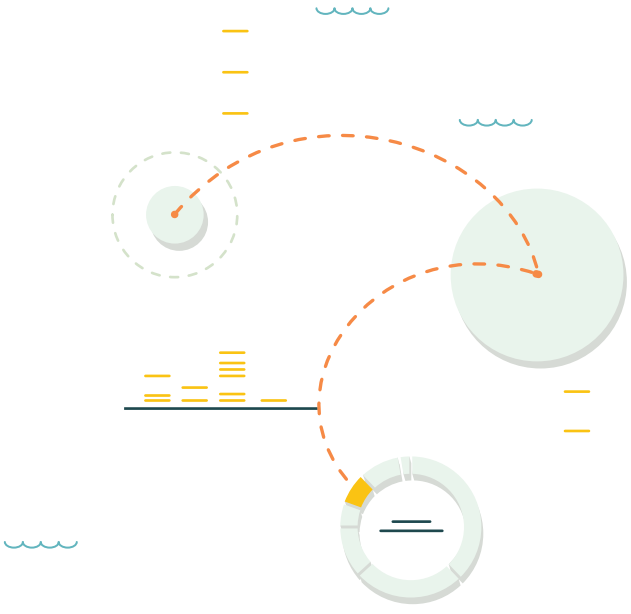
F. Noel Perry

F. Noel Perry
Founder

300 Brannan Street · Suite 402 / San Francisco · California 94107

TABLE OF CONTENTS





INTERNATIONAL INDEX AT A GLANCE

CARBON ECONOMY

PAGE 15

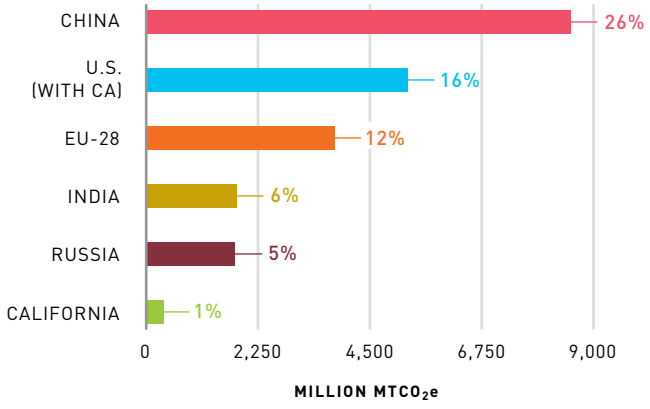
The top five polluters of energy-related GHG emissions accounted for 65 percent of global emissions in 2012, with China ranking as the largest emitter followed by the United States (U.S.). California ranks 20th in energy-related GHG emissions.

France ranks first as the least carbon intensive economy, followed by California in second, emitting fewer emissions per dollar of GDP compared to other large emitters. In addition, some developed areas such as California and the EU-28 have achieved economic growth while meeting emissions reduction benchmarks.

Nigeria had the lowest emissions per capita out of the biggest emitters, and other developing or moderate-income countries took top spots.

TOP GHG EMITTERS AND SHARE OF GLOBAL EMISSIONS

EMISSIONS FROM ENERGY CONSUMPTION, 2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Greenhouse gas emissions are from consumption of energy. Data Source: U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

CARBON ECONOMY RANKING

2012 LOWEST CARBON INTENSITY

RANK	REGION	$MTCO_2e$ / US $10,000 GDP
1	FRANCE	1.39
2	CALIFORNIA	1.68
3	ITALY	1.91
4	NIGERIA	2.11
5	UNITED KINGDOM	2.14
6	BRAZIL	2.25
7	JAPAN	2.27
8	SPAIN	2.29
9	GERMANY	2.29
10	EU-28	2.29
16	U.S. (WITH CALIFORNIA)	3.39
46	CHINA	12.25

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of the top 50 in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis, USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

EMISSIONS PER CAPITA RANKING

2012 LOWEST EMISSIONS PER PERSON

RANK	REGION	$MTCO_2e$ / PERSON
1	NIGERIA	0.51
2	PAKISTAN	0.77
3	PHILIPPINES	0.81
4	VIETNAM	1.44
5	INDIA	1.52
6	INDONESIA	1.83
7	EGYPT	2.47
8	BRAZIL	2.51
9	ALGERIA	3.58
10	TURKEY	3.72
20	CHINA	6.36
31	CALIFORNIA	9.16
44	U.S. (WITH CALIFORNIA)	16.77

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of the top 50 in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

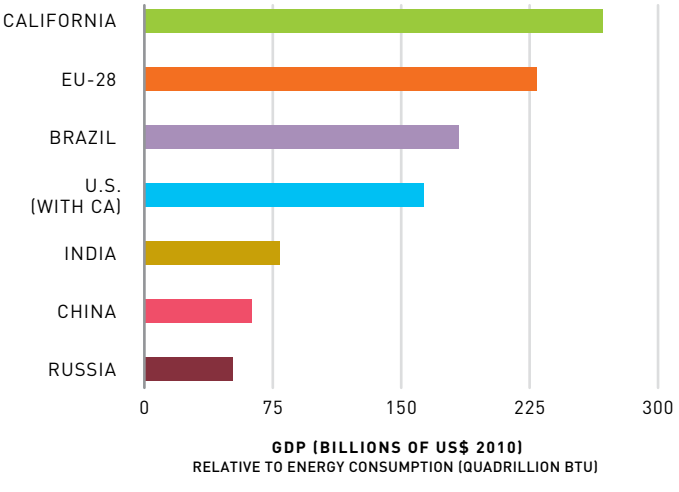
ENERGY EFFICIENCY

PAGE 28

California's early and sustained adoption of energy policies has generated improvements in energy efficiency and productivity. In 2012, California generated nearly 64 percent more GDP for every unit of energy consumed compared to the United States as a whole. China and Russia, in comparison, have relatively poor energy productivity. Looking at energy per person, the U.S. has one of the highest per capita energy consumption rates, while India has one of the lowest. California has improved compared to 1990, but still has a relatively high rate of energy consumed per person on the world stage.

ENERGY PRODUCTIVITY

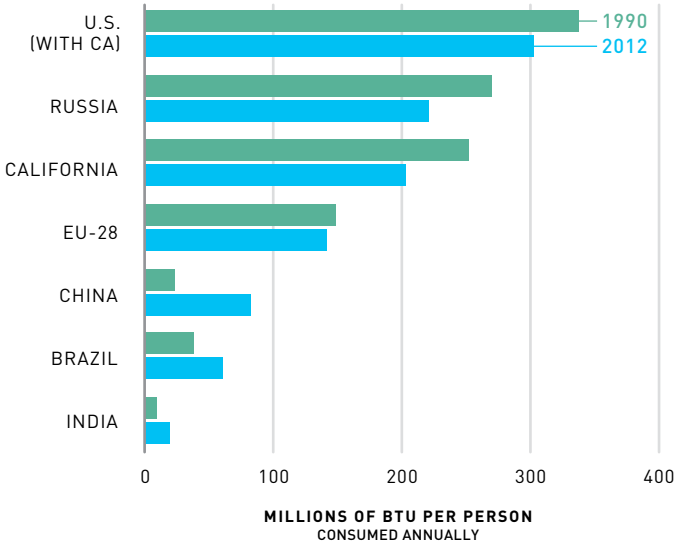
GDP RELATIVE TO TOTAL ENERGY CONSUMPTION, 2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economics Analysis; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

ENERGY PER CAPITA

TOTAL ENERGY CONSUMPTION PER PERSON, 1990 AND 2012



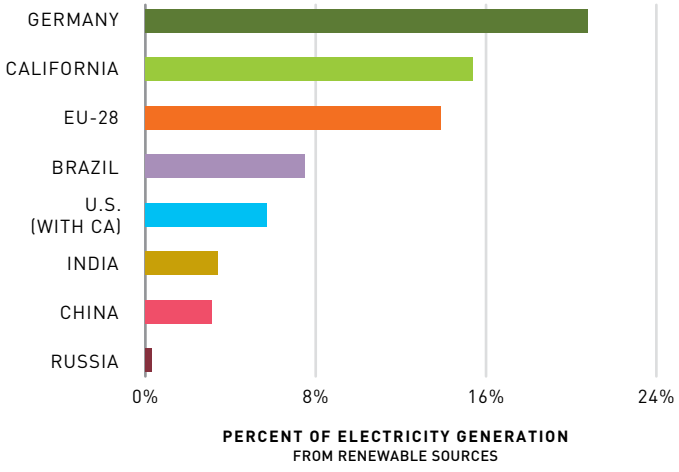
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

RENEWABLE ENERGY

PAGE 33

In 2012, Germany was a leader in renewable energy adoption with 21 percent of electricity coming from renewable sources, while California also ranked high with 15 percent of total electricity from renewables. More recently, Germany generated 27 percent of electricity from renewables in the first half of 2014, while California jumped to 23 percent. The EU-28 had the highest total renewable electricity generation in 2012 followed by the U.S., and their percent of total electricity from renewables was 14 percent and 6 percent, respectively.

PERCENT OF TOTAL ELECTRICITY GENERATION FROM RENEWABLE SOURCES, 2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Renewables do not include large hydro. Data Source: California Energy Commission; U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

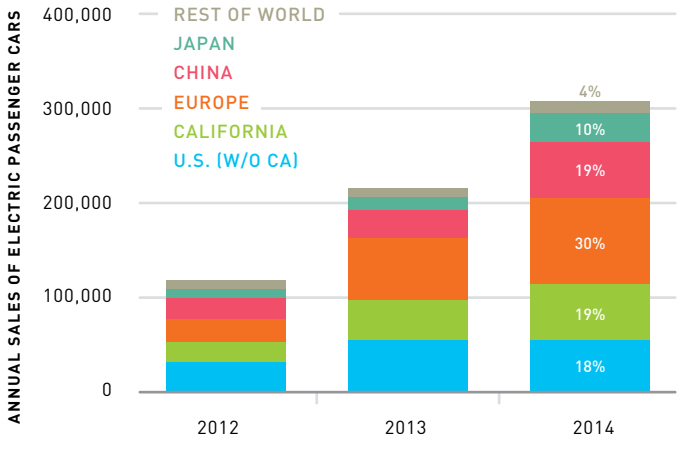
TRANSPORTATION

PAGE 38

Transportation is one of the principle sources of GHG emissions and the transition to cleaner vehicles is an important strategy to reduce these emissions. With a high percentage of emissions from transportation, California has been a leader in developing strong zero emission vehicle policies and programs, and accounted for 19 percent of global electric vehicle sales in 2014, more than any single country aside from the United States as a whole. The EU as a whole had 30 percent, followed by China with 19 percent and the U.S. (without California) at 18 percent.

GLOBAL SALES OF ELECTRIC VEHICLES (PASSENGER CARS)

2012–2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Global data - Mock, P., Yang, Z. (2014). Updated ICCT Data. Driving electrification: A global comparison of fiscal policy for electric vehicles; California data - Polk. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

ACRONYMS AND TERMS

ARB
(California) Air Resources Board

BTU
British Thermal Unit (traditional unit of energy)

CA
California

CARBON INTENSITY
Emissions relative to gross domestic product

EMISSIONS PER CAPITA
Emissions per person, also known as carbon footprint

ETS
Emissions Trading Scheme

EU (OR EU-28)
European Union (28 countries)

GDP
Gross Domestic Product

GHG
Greenhouse Gas Emissions

IPCC
Intergovernmental Panel on Climate Change

IPO
Initial Public Offering

kWh
Kilowatt Hour

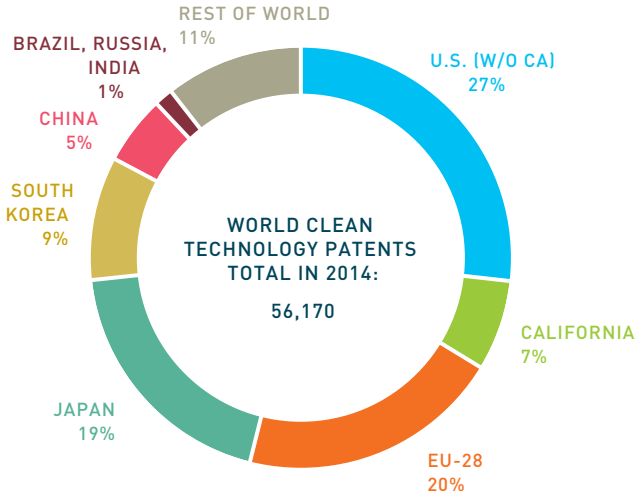
CLEAN TECHNOLOGY INNOVATION

PAGE 40

California and the U.S. continue to be the leaders in clean technology innovation, with its companies receiving the majority of investment and ranking highest in global patents. California clean technology companies alone received half of global venture capital investment in 2014. The U.S. (without California) had the most clean technology patents in 2014, followed by the EU-28 and Japan.

GLOBAL CLEAN TECHNOLOGY PATENTS

BY RESIDENCE OF FIRST INVENTOR, 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

CLEAN TECHNOLOGY VENTURE CAPITAL INVESTMENT

TOP REGIONS IN BILLIONS OF US$

RANK	REGION	2014
1	U.S. (WITH CALIFORNIA)	$8.208
2	CALIFORNIA	$5.691
3	EU-28	$1.028
4	CHINA	$1.022
5	UNITED KINGDOM	$0.436
6	SINGAPORE	$0.334
7	FRANCE	$0.187
8	CANADA	$0.185
9	INDIA	$0.167
10	ISRAEL	$0.167
	WORLD TOTAL	$11.361

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal), the company Uber accounted for $3 billion of the California, the U.S., and the World total in 2014. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

M&A
Merger and Acquisition

MOU
Memorandum of Understanding

$MTCO_2e$
Metric Tons of Carbon Dioxide Equivalent

MW
Megawatt

OECD
Organisation for Economic Co-operation and Development

PPP
Purchasing Power Parity

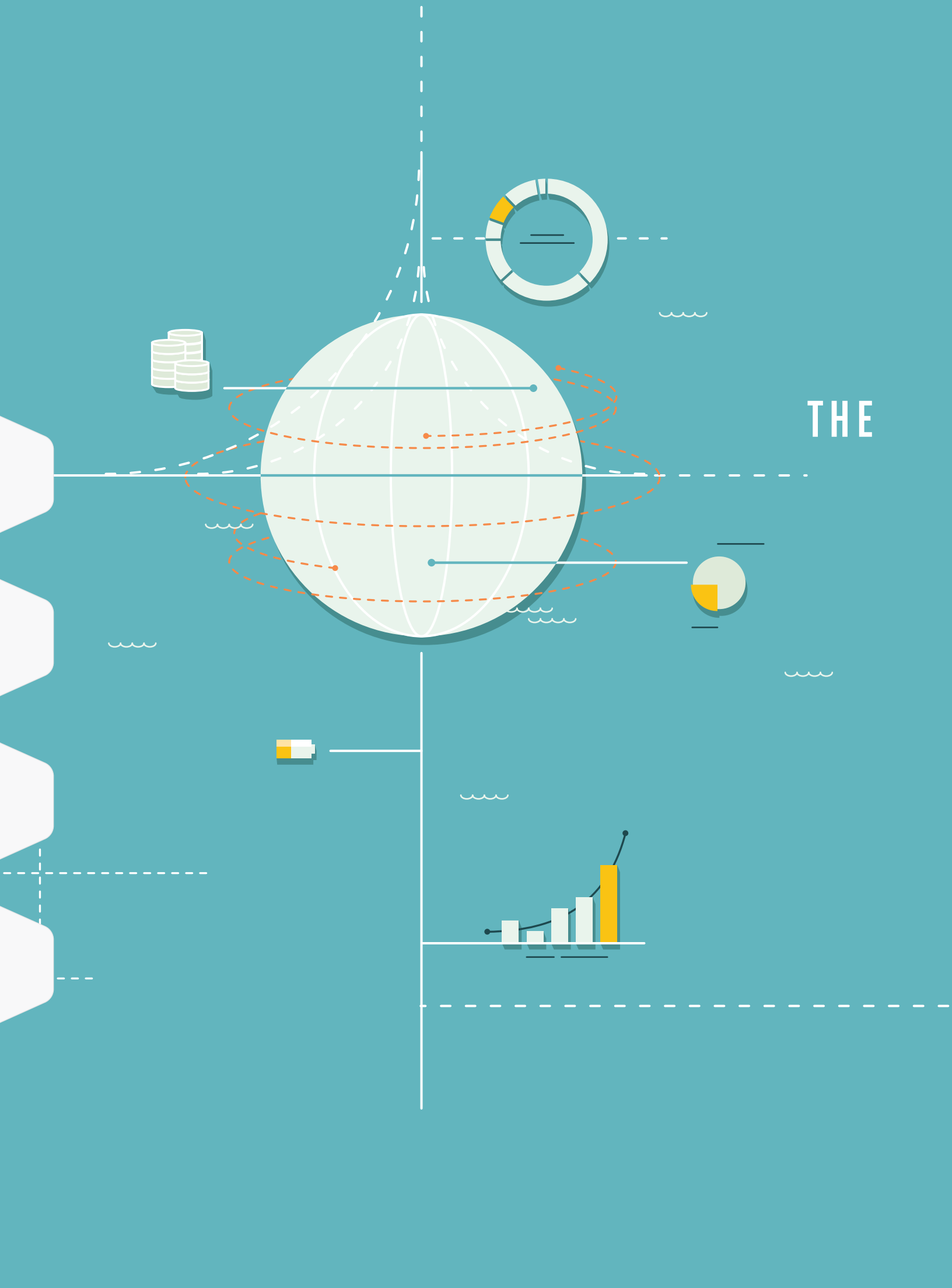
R20
Regions of Climate Action

RGGI
Regional Greenhouse Gas Initiative

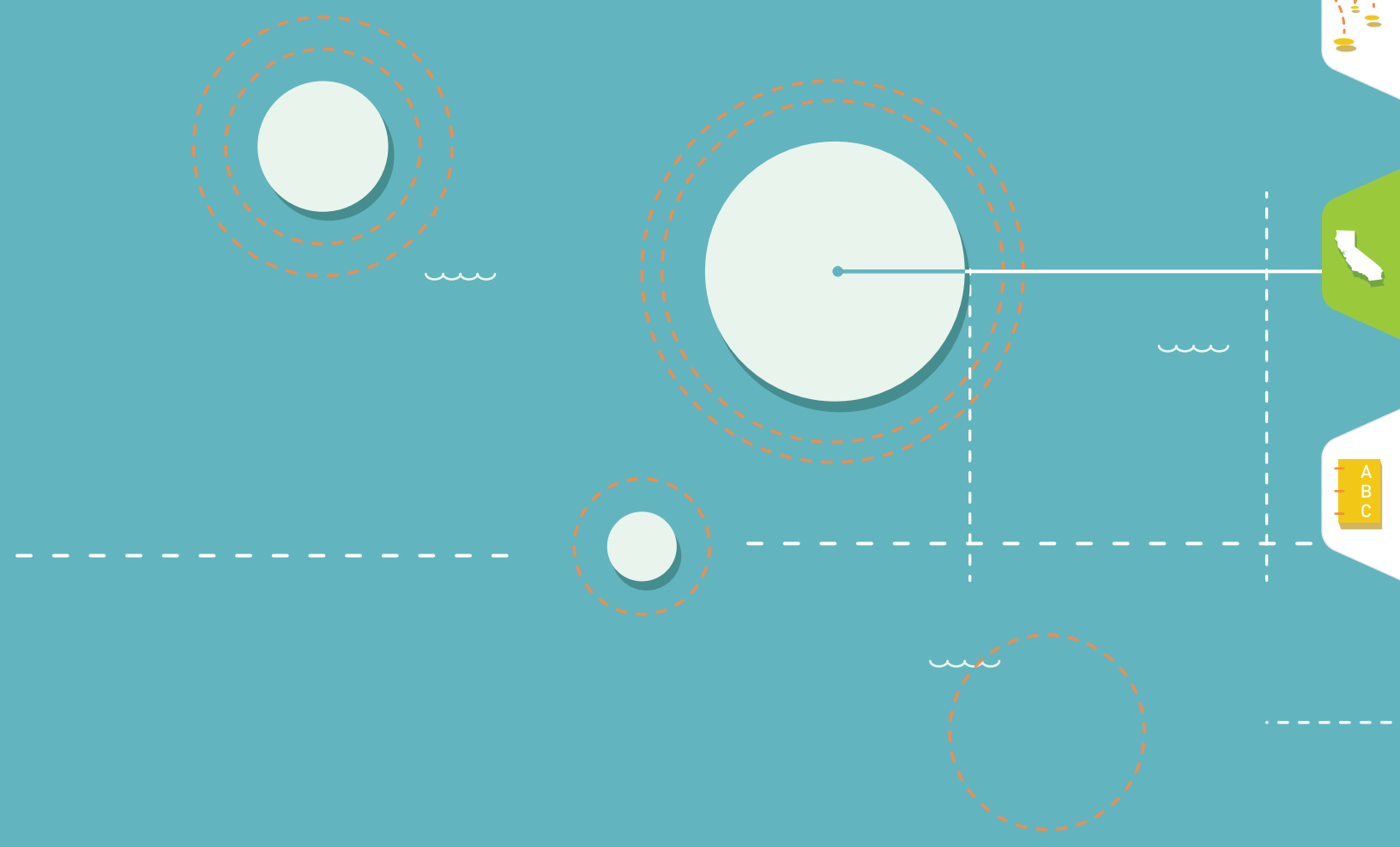
UNFCCC
United Nations Framework Convention on Climate Change

U.S.
United States

W/O
Without


THE

INTERNATIONAL INDEX



ANSWERING THE CALL TO CLIMATE ACTION

INTRODUCTION

Climate change is presenting risks to economies and the natural environment around the world. The Intergovernmental Panel on Climate Change (IPCC) determined that greenhouse gas (GHG) emissions from human activities are interfering with the climate system, and suggests limiting global temperature increase to approximately 2°C above preindustrial levels to avoid catastrophic change.[1] Climate action is needed from countries, sub-national entities, and companies around the world in order to keep the earth below this limit and avoid dangerous climate change impacts. International negotiations have yet to achieve strong global GHG reduction commitments, but recent progress has been made to lay the groundwork for the upcoming 21st Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) in Paris, France in late 2015. The 2009 Copenhagen Accord is the current UNFCCC agreement for emissions targets by the year 2020, and the UNFCCC meeting in Paris will lay the foundation for climate action past 2020.

For the last eight years, economic and environmental indicators in the *California Green Innovation Index* have shown that robust climate action is possible while also achieving economic growth. A recent Organisation for Economic Co-operation and Development (OECD) report reinforced the finding that strong environmental policies can be implemented without hurting economic performance.[2] California is a leader in the United States (U.S.) for GHG reduction policies and innovative clean technology breakthroughs, but how does it compare internationally? The 2015 *California Green Innovation Index: International Edition* recognizes that California has made significant progress in reducing its environmental impact, but there is still room for improvement in policies, programs, and innovation to address the global challenge of climate change. As one of the largest economies in the world, this *International Edition* compares California's trends to show areas of opportunity for improvement and where California is leading other nations.

SUB-NATIONAL CLIMATE COMMITMENTS: CALIFORNIA IS LEADING THE ACTION

In the absence of robust international agreement and national action plans for GHG reductions, sub-national entities are enacting strong climate commitments. For example, the German State of Baden-Württemberg adopted the Climate Protection Act in 2013, which includes a target to reduce GHG emissions by 25 percent compared to 1990 levels by the year 2020, and goals for increasing renewable energy and energy efficiency.[3] Several Canadian provinces are also taking action. Ontario, for example, officially shut down all coal-fired electricity plants in the province in 2014, which is considered to be the largest single emissions reduction initiative in North America. Quebec has a goal to reduce GHG emissions 20 percent below 1990 levels by 2020. In 2014, Quebec linked its cap-and-trade system to California's, and in 2015 Ontario announced plans to establish a cap-and-trade system and link to Quebec and California.[4] Nonprofit organizations such as Regions of Climate Action (R20) and The Climate Group have also emerged to leverage sub-national commitments, share best practices, and advance clean energy projects around the world.

California is a historic leader in sub-national climate commitments. The state passed a law in 2006 that set a target of reaching 1990 emissions levels by the year 2020, and established strong supportive actions such as an economy-wide cap-and-trade system, renewable energy targets, emissions standards for power plants and vehicles, the Low Carbon Fuel Standard, and other policies. In April 2015, California set an ambitious new target of reducing GHG emissions 40 percent below 1990 levels by 2030. California is working directly with national and sub-national entities to share and leverage its experience through major international and regional agreements, and is actively participating in international climate events. For example, California has Memoranda of Understanding (MOU) and other agreements with nations such as China, Peru, Mexico, and Israel, as well as states and regions across the world (see Figure 1 for full list) that include a range of opportunities for collaboration and action. The 2013 MOU with China, for example, focuses on low carbon strategies and trade in clean energy technologies. The 2014 MOU with Mexico commits the entities to collaborating on climate change, human and environmental health, and other issues, including carbon pricing specifically. California is also leading action among U.S. states, such as the eight-state Zero Emissions Vehicle Agreement and the Pacific Coast Action Plan on Climate and Energy with Oregon and Washington and the Canadian province of British Columbia.[5]

Moving forward, California is galvanizing action among regions in the R20 to establish an MOU to limit the increase in global average temperature to 2°C. On the road to UNFCCC Paris climate negotiations in late 2015, this agreement would include specific emissions reduction commitments and illustrate broad sub-national support for international action.

WHY REDUCE GHG EMISSIONS?

In 2014, the IPCC — a widely respected international scientific body that reviews and assesses scientific, technical and socio-economic information to better understand climate change — reported with greater certainty than ever before that GHG emissions and other human drivers have been the dominant cause of warming since 1950.[6] This climate disruption is projected to increase and is already causing damage to economies as well as changes to human and natural systems across the world, including rising sea levels, changing precipitation and melting snow/ice, and extreme weather events such as superstorms, droughts, heat waves, floods, and wildfires. In addition, climate change can reduce crop yields in many regions and shift agricultural growing zones.[7]

The least developed countries and vulnerable communities, such as poor and marginalized areas, are most at risk because of their limited ability to adapt. Factors such as socioeconomic status, gender, age, and income, along with exposure to climate change impacts, influence vulnerability. Africa and Southeast Asia are particularly vulnerable to impacts on human health from extreme weather, water availability, and food security.[8]

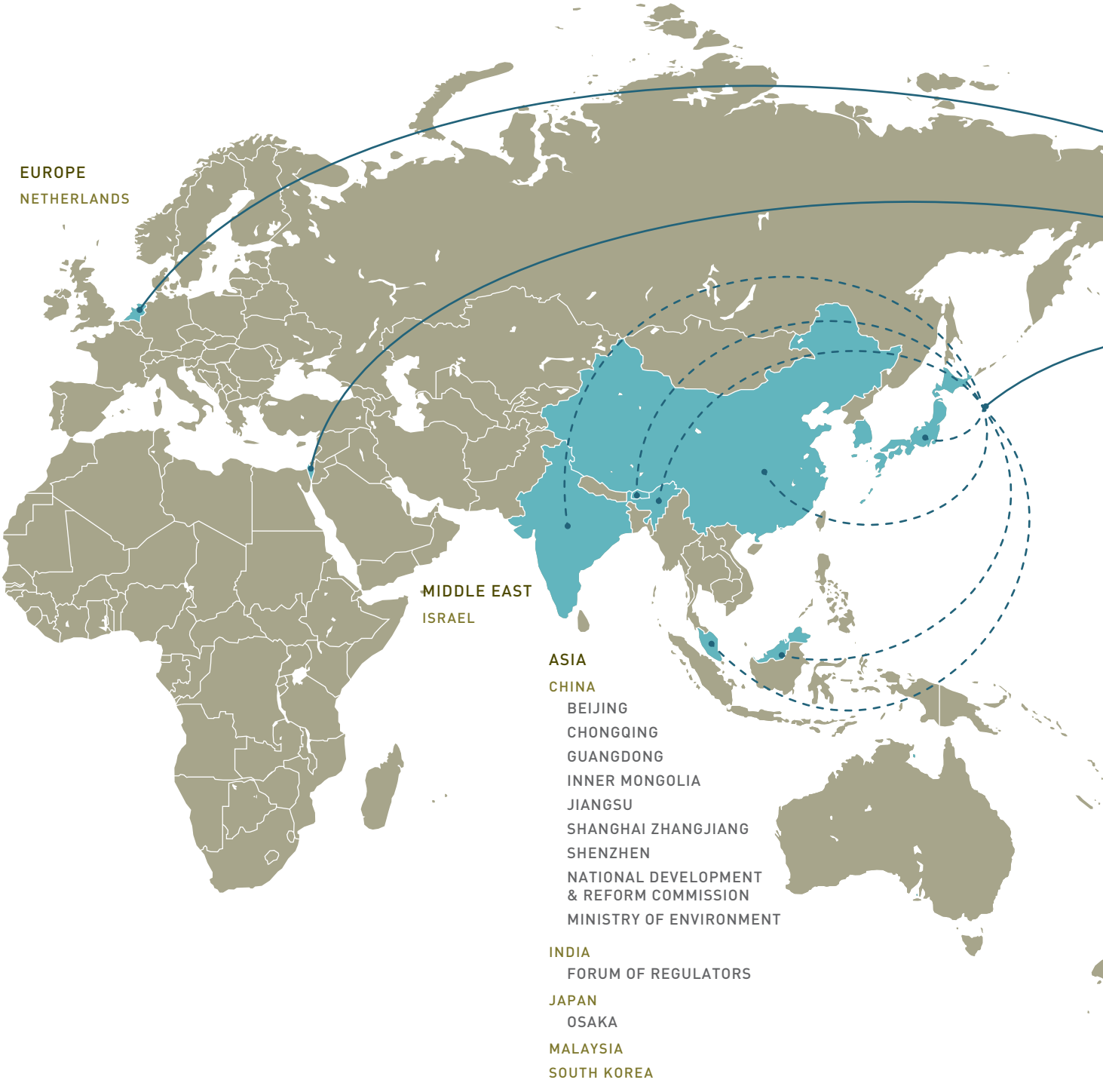
Developed countries, the primary emitters of GHGs, are not immune to climate change impacts. The U.S., for example, is facing water supply challenges, threats to food supply, sea level rise, and increased heat waves and wildfires.[9] In California, climate change is likely to decrease snow pack, which will increase the state's water challenges, the frequency of wildfires is expected to increase, and rising sea levels may threaten coastal areas.[10] Climate change is a global problem and requires strong national and international action in order to reduce the long-term impacts. California, an early actor in addressing GHG emissions, has demonstrated that climate change policy can spur the production of innovative technologies and the efficient use of resources, creating economic opportunities and driving investment.

→ The Importance of the 2015 UNFCCC Paris Climate Negotiations

Government, business, and nonprofit leaders are working towards a legally-binding climate agreement to reduce GHG emissions starting in 2020. The current 2009 Copenhagen Accord is effective through 2020, and reaching an agreement at the upcoming UNFCCC meeting in Paris, France in late 2015 is critical for climate action past 2020.

Climate leaders are stressing the importance of the Paris meeting because of the need to start curbing emissions in order to limit warming to 2°C above preindustrial levels and avoid catastrophic climate change impacts. In February 2015 at the UN climate talks in Geneva, leaders made an important step towards a Paris agreement by establishing a formal draft negotiating text. This draft document will form the basis for the Paris negotiations. Governments are now expected to submit their national action plans by summer 2015 to support the international climate agreement.

FIGURE 1. CALIFORNIA AGREEMENTS WITH STATES AND REGIONS THROUGHOUT THE WORLD



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Environmental Protection Agency, Air Resources Board. Agreements as of December 2014. NEXT 10 / SF · CA · USA

NORTH AMERICA

UNITED STATES
- CONNECTICUT
- ILLINOIS
- MASSACHUSETTS
- MARYLAND
- NEW YORK
- OREGON
- RHODE ISLAND
- VERMONT
- WASHINGTON
- WISCONSIN

MEXICO
- MINISTRY OF ENERGY
- MINISTRY OF ENVIRONMENT
- BAJA CALIFORNIA
- CHIAPAS
- STATE OF MEXICO

PACIFIC COAST COLLABORATIVE
- BRITISH COLUMBIA
- OREGON
- WASHINGTON

QUEBEC AND CALIFORNIA CAP-AND-TRADE LINKAGE
- QUEBEC

SOUTH AMERICA

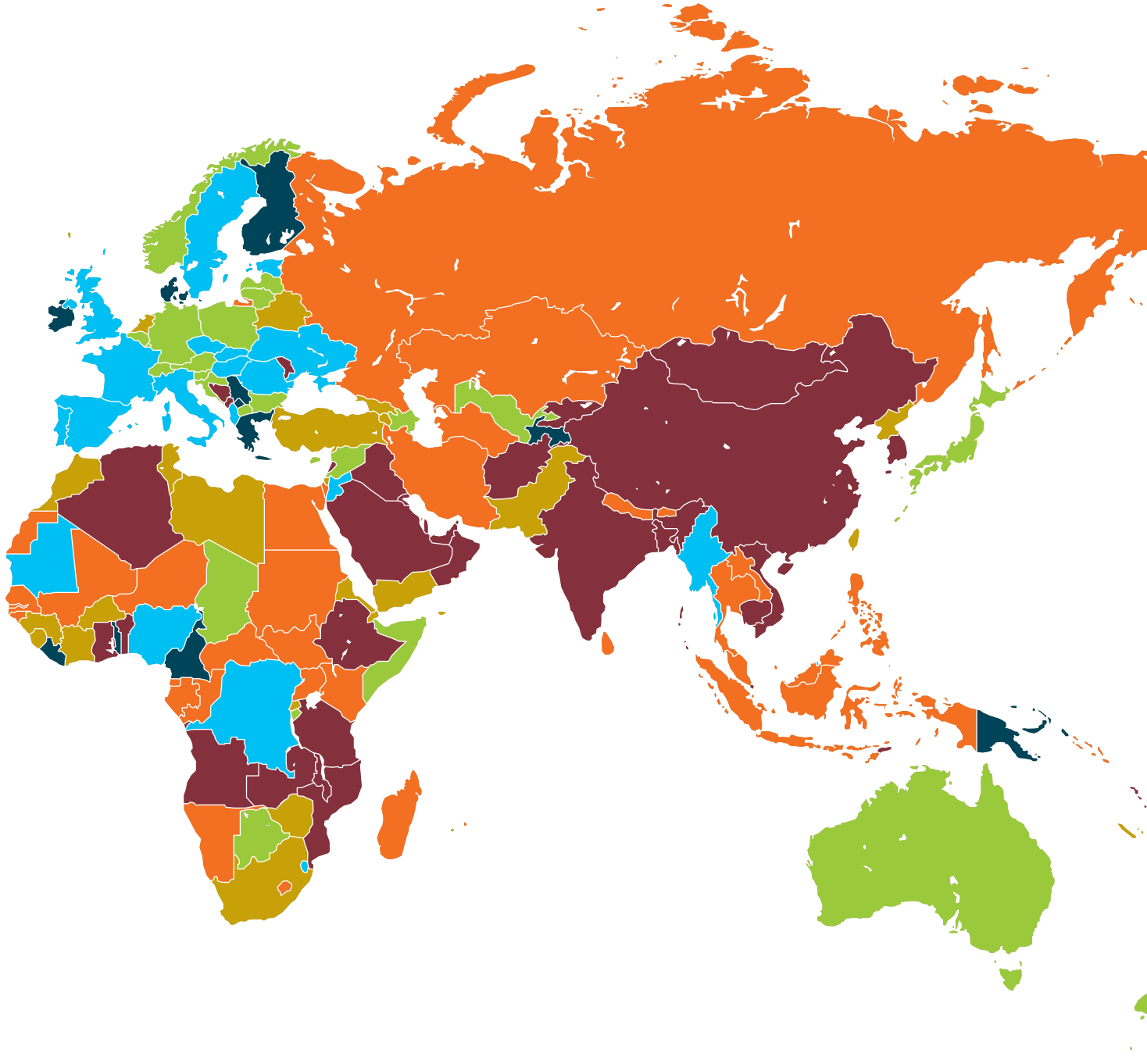
BRAZIL
- STATE OF ACRE

CHILE

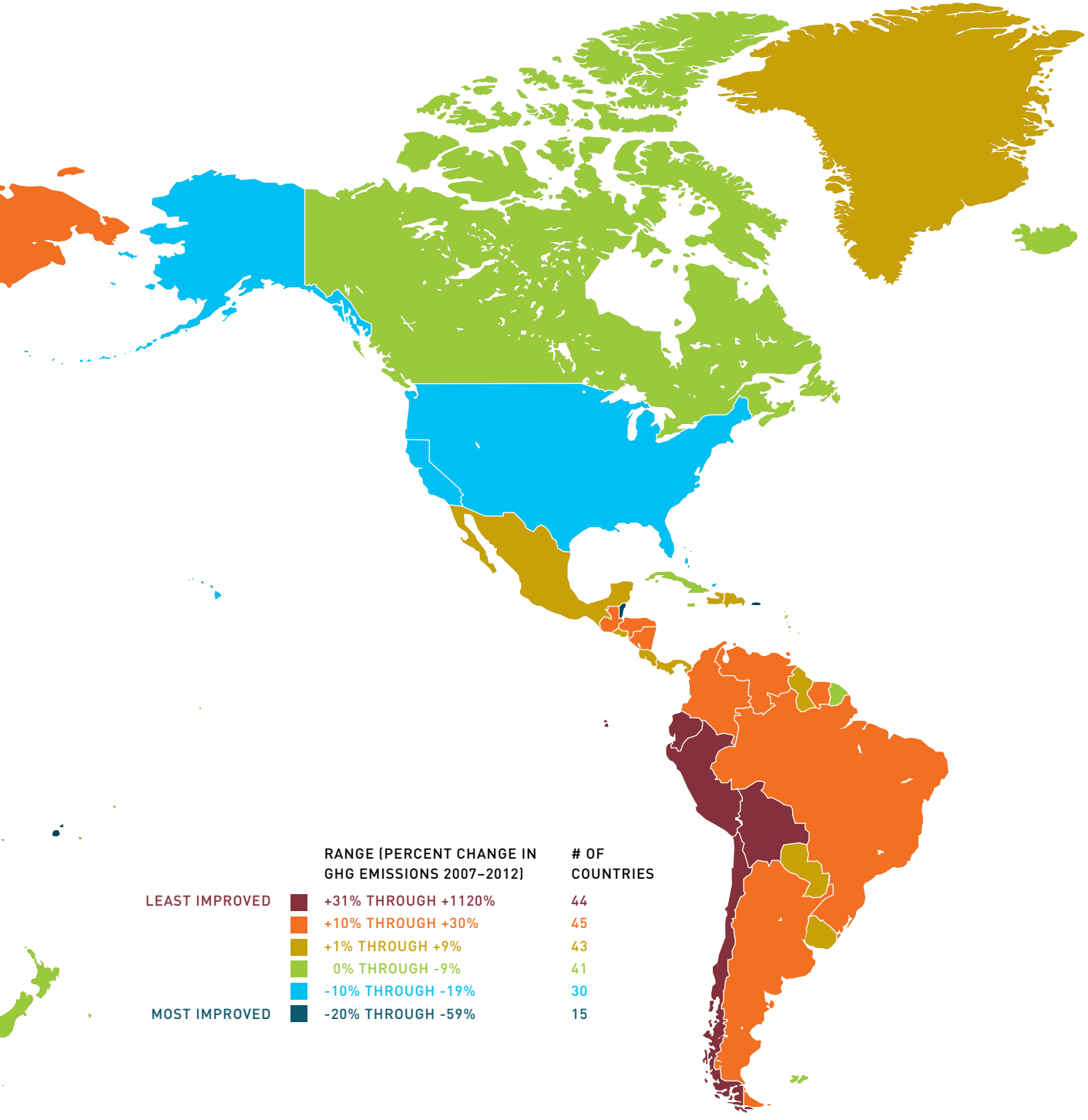
PERU

FIGURE 2. CHANGE IN GREENHOUSE GAS EMISSIONS FROM ENERGY CONSUMPTION

PERCENT CHANGE FROM 2007 TO 2012

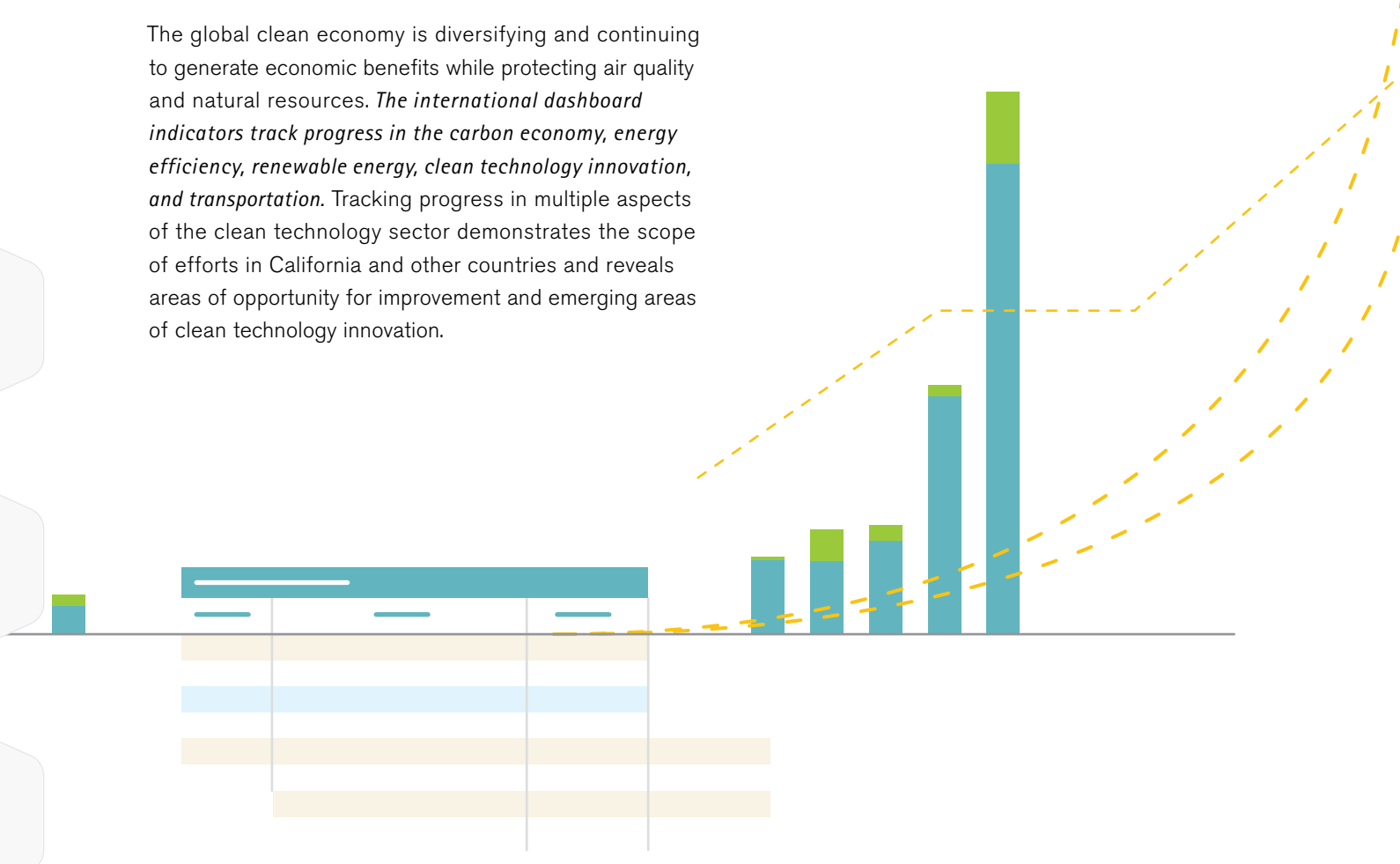


NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA


RANGE (PERCENT CHANGE IN GHG EMISSIONS 2007–2012)
OF COUNTRIES
LEAST IMPROVED
+31% THROUGH +1120%
44
+10% THROUGH +30%
45
+1% THROUGH +9%
43
0% THROUGH -9%
41
-10% THROUGH -19%
30
MOST IMPROVED
-20% THROUGH -59%
15

INTERNATIONAL DASHBOARD INDICATORS

The global clean economy is diversifying and continuing to generate economic benefits while protecting air quality and natural resources. *The international dashboard indicators track progress in the carbon economy, energy efficiency, renewable energy, clean technology innovation, and transportation.* Tracking progress in multiple aspects of the clean technology sector demonstrates the scope of efforts in California and other countries and reveals areas of opportunity for improvement and emerging areas of clean technology innovation.



THE CARBON ECONOMY

WHY IS IT IMPORTANT?

In order to meet international and state goals for reducing emissions, it is necessary to find cleaner ways to create, transport, use, and dispose of our products. Indicators relating to the carbon economy help track this shift and illustrate the changing relationship between economic vitality and environmental quality.

CARBON ECONOMY INDICATORS

In order to limit the increase in average global temperature to 2°C above preindustrial levels, the United Nations Environment Programme calculates that emissions need to peak soon and global carbon neutrality (i.e. the amount emitted is equal to the amount absorbed) needs to be reached between 2055 and 2070.[11] California has demonstrated that GHG emissions reductions can be achieved while boosting the economy, which is a key lesson in the path to global carbon neutrality. California and other entities have been taking action to reduce GHG emissions compared to 1990 (the base year for many GHG reduction targets). However, at the same time there are nations, particularly developing countries, which are rapidly increasing emissions as their economies grow. Preliminary data from the International Energy Agency show that global emissions remained unchanged between 2013 and 2014, even as the global economy increased 3 percent, which is the first time in the last 40 years that a decrease or steady emissions was not associated with an economic crisis.

The top 20 polluters of energy-related GHG emissions account for more than 80 percent of global emissions (Table 1).[12] China is the largest emitter, with about 8,550 million metric tons of carbon dioxide equivalent ($MTCO_2e$). China accounted for a quarter of global emissions in 2012, followed by the United States with 16 percent. In November

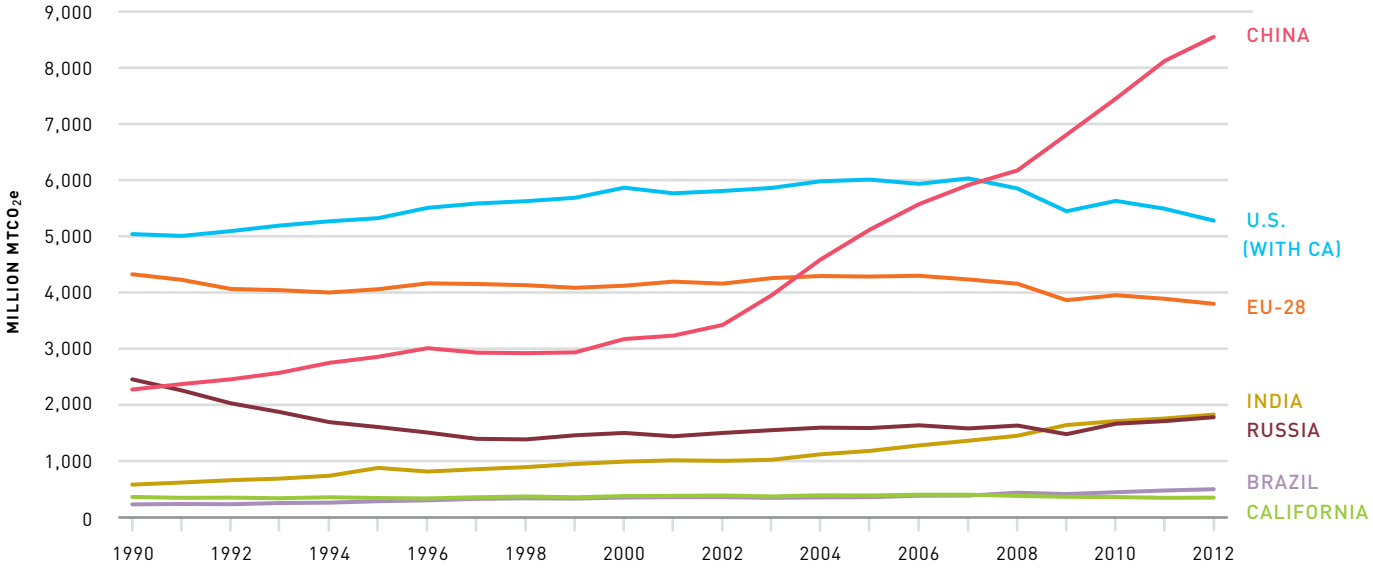
TABLE 1. TOTAL GREENHOUSE GAS EMISSIONS FROM ENERGY CONSUMPTION

TOP 20 POLLUTERS *see top 50 rankings on page 54*

RANK	REGION	MILLION $MTCO_2e$, 2012	1990–2012 % CHANGE	SHARE OF GLOBAL EMISSIONS, 2012	SHARE OF GLOBAL POPULATION, 2012
1	CHINA	8547.8	277%	26%	19.4%
2	U.S. (WITH CALIFORNIA)	5270.4	5%	16%	4.5%
3	EU-28	3796.9	-12%	12%	7.3%
4	INDIA	1830.9	216%	6%	17.5%
5	RUSSIA	1781.7	-27%	5%	2.0%
6	JAPAN	1259.1	20%	4%	1.8%
7	GERMANY	788.3	-20%	2%	1.2%
8	SOUTH KOREA	657.1	171%	2%	0.7%
9	IRAN	603.6	199%	2%	1.1%
10	SAUDI ARABIA	582.7	180%	2%	0.4%
11	CANADA	550.8	17%	2%	0.5%
12	BRAZIL	500.2	111%	2%	2.9%
13	UNITED KINGDOM	498.9	-17%	2%	0.9%
14	SOUTH AFRICA	473.2	59%	1%	0.7%
15	INDONESIA	456.2	192%	1%	3.6%
16	MEXICO	453.8	50%	1%	1.7%
17	AUSTRALIA	420.6	57%	1%	0.3%
18	ITALY	385.8	-7%	1%	0.9%
19	FRANCE	364.5	-1%	1%	0.9%
20	CALIFORNIA	344.9	-5%	1%	0.5%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Top 20 regions account for a total of 83% of global emissions (does not double count California or individual EU countries).
Data Source: U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 3. TOP GREENHOUSE GAS EMITTERS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Greenhouse gas emissions are from consumption of energy. Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

COUNTRY HIGHLIGHTS

CHINA

#1 in GHG emissions from energy consumption

Emissions per capita = 6.36, GDP per capita = $6,800
Pledge: GHG emissions intensity 40–45% below 2005 levels by 2020

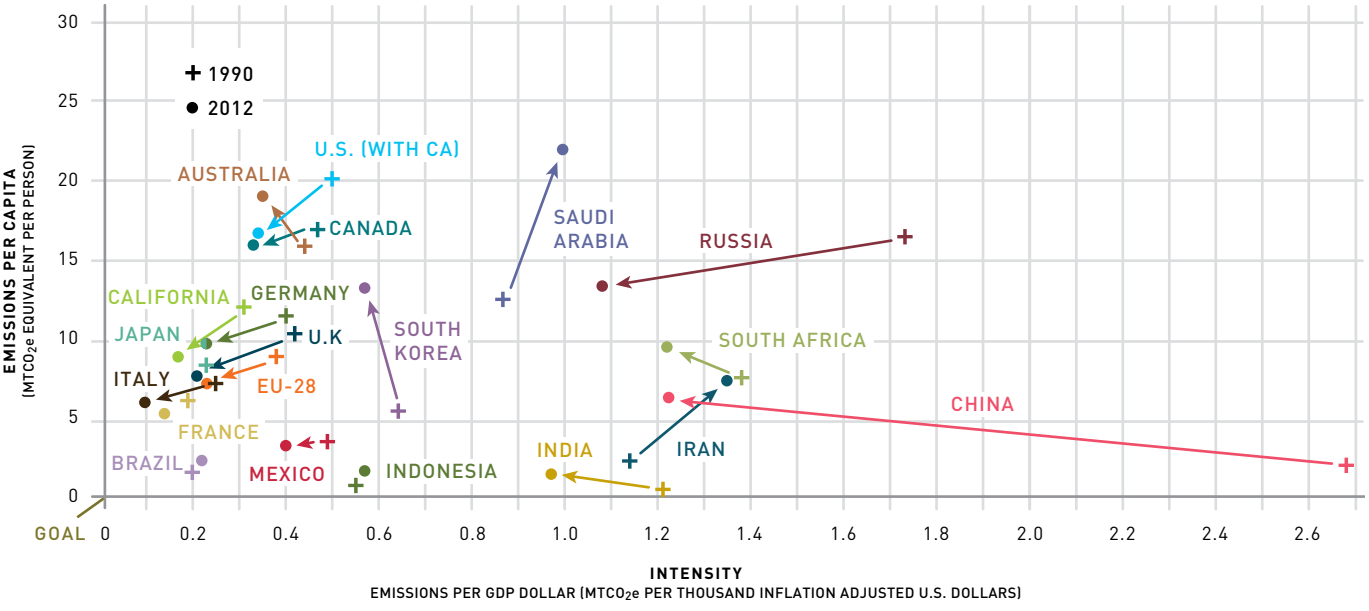
China is a rapidly developing country with the highest total GHG emissions from energy consumption. It has the largest population and emissions per capita are less than half that of the United States. China also has the second highest total GDP, though it is one of the bottom countries in terms of carbon intensity (emissions/GDP), ranking #46. While China currently accounts for 26 percent of global emissions, historically it contributed only 12 percent of total cumulative emissions from 1850–2010. China's National Bureau of Statistics estimated that emissions fell 2 percent between 2013 and 2014, as energy consumption shifted towards cleaner sources and away from coal and the economy grew at its slowest pace since 1990.

As a developing country with ever increasing energy demands, China has historically been reluctant to commit to absolute carbon reductions. However, in 2010, China pledged in the Copenhagen Accord to reduce emissions intensity 40–45 percent below 2005 levels by 2020, increase the share of non-fossil fuels in primary energy consumption to around 15 percent by 2020, as well as increase forest coverage.[32] In November 2014, China announced a landmark bi-lateral agreement with the U.S. to peak CO_2 emissions around 2030 and to increase the share of non-fossil fuels in primary energy consumption to 20 percent by 2030.[33] To achieve these goals, China has a range of supporting goals in its 12th Five Year Plan (2011–2015), including a cap on coal consumption, energy efficiency improvements, and renewable energy developments.[34]

China also plans to establish a nationwide carbon trading market by 2016,[35] and several regions in the country have already started pilot programs. Seven test markets started in 2013 and 2014 and cover two provinces and five major cities. As of October 2014, these markets combined have already traded 13.75 million $MTCO_2e$ and generated $81 million.[36]

FIGURE 4. GLOBAL FOSSIL FUEL COMBUSTION IN CALIFORNIA AND OTHER REGIONS

CARBON INTENSITY AND EMISSIONS PER CAPITA, 1990 TO 2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GDP in Real 2010 U.S Dollars. Greenhouse gas emissions are from consumption of energy. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis, USDA Economic Research Service; U.S. Census Bureau; The California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

2014, the U.S. and China made a joint commitment to reduce carbon pollution, which is a vital action as they are the two largest emitters, and is an important step in reaching a global climate agreement in Paris. Preliminary data show that China's emissions decreased in 2014 as energy consumption shifted towards cleaner sources and away from coal, and the economy increased at its slowest rate since 1990.

The 28 countries in the European Union (EU-28) collectively were the third largest emitters in 2012, accounting for 12 percent of the global total. India and Russia round out the top five polluters with the fourth and fifth highest emissions, respectively. California ranks 20th in energy-related emissions and is responsible for about 1 percent of the global total. In recent years, Saudi Arabia grew the fastest out of the top 20 polluters with a 24 percent increase between 2010 and 2012 as their economy and energy use expanded. China (+15%), South Korea (+13%), and Brazil (+11%) had the next largest increases in emissions between 2010 and 2012.

China's GHG emissions surged in the last decade, and it had nearly four-times more emissions in 2012 compared to 1990 (Figure 3). India had the next highest growth, with more than triple the amount of emissions in 2012 relative to 1990. Russia had the largest decrease (-27%) between 1990 and 2012, which is primarily attributed to the collapse of the Soviet Union in 1991. The U.S. increased emissions by 5 percent between 1990 and 2012, while California's emissions decreased 5 percent. California's recent shutdown of the San Onofre nuclear power plant is expected to result in short-term emissions increases post-2012, and energy to replace the plant is expected to be a mixture of renewable energy, energy efficiency, and natural gas.

California ranks among the most efficient and least carbon intensive economies in the world, and is progressing towards the goal of lowering emissions per capita and reducing carbon intensity (emissions per dollar of gross domestic product [GDP]) along with other regions such as the EU-28, U.S., and Canada (Figure 4). In contrast, some countries moved away from the goal between 1990 and 2012, including Saudi Arabia and Iran with increases in both intensity and per capita emissions, and Australia and China with increases in emissions per capita.

Regions have demonstrated long-term reductions in emissions per capita are possible while growing the economy (Table 2). Between 1990 and 2012, entities such as the U.S., EU-28, Russia, and California reduced emissions per person and increased GDP per person. China had dramatic increases in

TABLE 2. GHG EMISSIONS AND GDP PER CAPITA

1990–2012 PERCENT CHANGE

REGION	$MTCO_2e$ / PERSON	GDP / PERSON
CHINA	222%	604%
U.S. (WITH CALIFORNIA)	-17%	37%
EU-28	-17%	36%
INDIA	120%	176%
RUSSIA	-24%	21%
JAPAN	17%	18%
GERMANY	-22%	35%
SOUTH KOREA	138%	170%
IRAN	120%	87%
SAUDI ARABIA	70%	53%
CANADA	-5%	35%
BRAZIL	58%	43%
AUSTRALIA	21%	53%
CALIFORNIA	-25%	37%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; The California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 3. CARBON ECONOMY RANKING

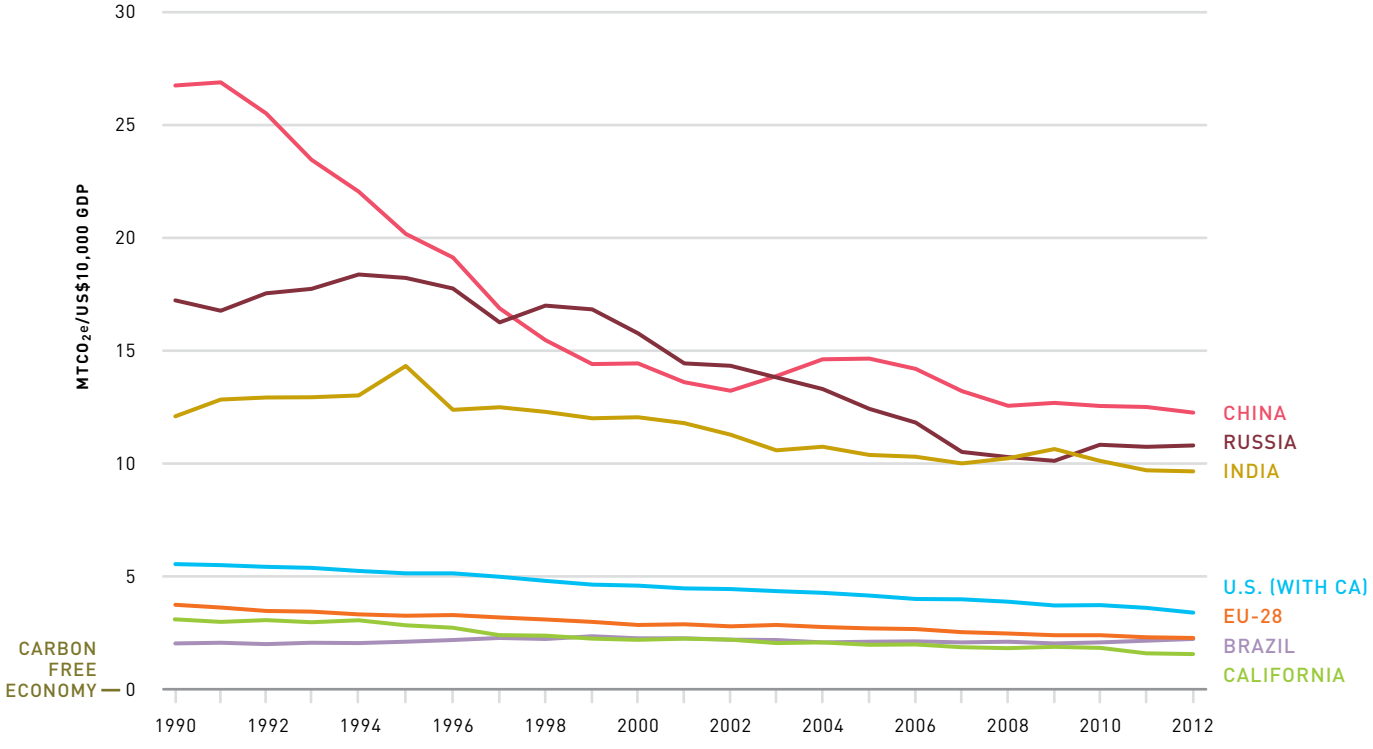
LOWEST CARBON INTENSITY IN 2012 *see top 50 rankings on page 56*

RANK	REGION	$MTCO_2e$ / $10,000 GDP
1	FRANCE	1.36
2	CALIFORNIA	1.68
3	ITALY	1.91
4	NIGERIA	2.11
5	UNITED KINGDOM	2.14
6	BRAZIL	2.25
7	JAPAN	2.27
8	SPAIN	2.29
9	GERMANY	2.29
10	EU-28	2.29
16	U.S. (WITH CALIFORNIA)	3.36
46	CHINA	12.25

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of the top 50 in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis, USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 5. THE CARBON ECONOMY

GHG EMISSIONS ($MTCO_2e$) RELATIVE TO GDP



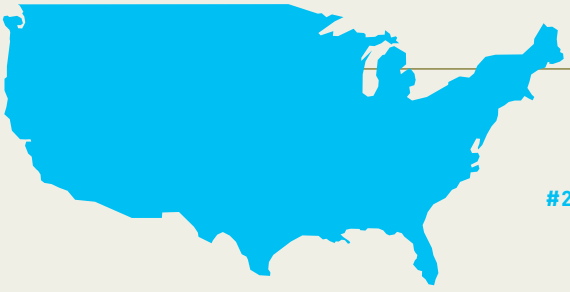
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: GDP in Real 2010 U.S. Dollars. Greenhouse gas emissions are from consumption of energy. Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

both measures, though increased GDP per capita at a faster rate than emissions per capita.

GDP does not factor in differences in cost of living, income, or social development, but is used in this report because it is the most commonly referenced (and available) measure of a region's economy. In addition, emissions indicators do not factor in whether a country imports or exports carbon intensive goods. China, for example, exports more to the U.S. and EU-28 than it imports, which contributes to higher emissions levels in China and lower emissions in the U.S. and EU-28.

France ranks first as the least carbon intensive economy, followed by California in second. Other top emitters ranked relatively well, such as Brazil (6th), Japan (7th), EU-28 (10th), and the U.S. (16th) (Table 3). The carbon economy (or intensity) measures emissions per dollar of GDP; countries with a lower intensity release fewer emissions for the same amount of economic activity. California's carbon intensity decreased 46 percent between 1990 and 2012 to 1.7 $MTCO_2e$ per $10,000 of GDP (Figure 5). The U.S. and EU-28 both decreased by 39 percent between 1990 and 2012. India and China also decreased over time, but still have relatively high carbon intensities.

Emissions per person (also known as carbon footprint) improved in California since 1990, with a 25 percent decrease in $MTCO_2e$ per capita, and the U.S. and EU-28 both decreased 17 percent over the same time period (Figure 6). China, in contrast, more than tripled its emissions per capita



COUNTRY HIGHLIGHTS

UNITED STATES

#2 in GHG emissions from energy consumption

Emissions per capita = 16.77, GDP per capita = $52,600
Goal: GHG emissions 17% below 2005 levels by 2020

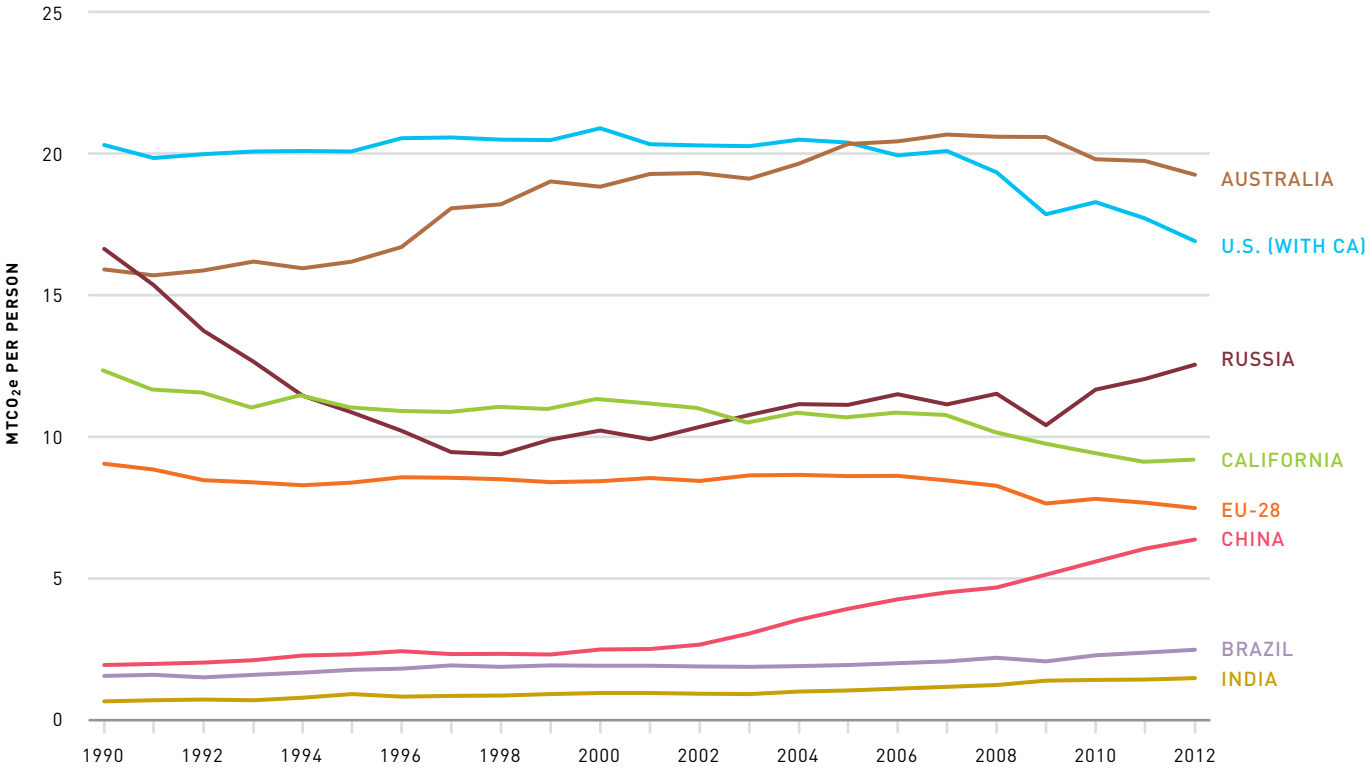
The U.S. has consistently lagged among developed countries on strong national climate action and international commitments. It is one of the largest oil, natural gas, and coal producer and consumer, and emits the second largest amount of energy-related GHG emissions. The U.S. has the highest total GDP in the world (slightly less than the EU-28 as a whole) and ranks 16th in carbon intensity, but has a high level of emissions per capita (#44). The U.S. was the largest single contributor of global GHG emissions between 1850 and 2010, accounting for 19 percent of the cumulative total.

While the U.S. Congress has failed to pass federal climate legislation, President Barack Obama has implemented a number of executive actions on climate change. In 2009, President Obama committed to reducing emissions 17 percent below 2005 levels by the year 2020. In November 2014, President Obama announced a bi-lateral climate agreement with China, with a U.S. goal of reducing emissions 26–28 percent below 2005 levels by 2025.[37] To achieve these goals, the administration has developed a Climate Action Plan to cut carbon pollution, prepare for the impacts of climate change, and lead international efforts to reduce emissions.[38] A cornerstone of reaching this goal is the Clean Power Plan, which was proposed by the Environmental Protection Agency in June 2014 to cut carbon emissions from power plants. This plan for existing power plants is expected to reduce emissions from the power sector 30 percent below 2005 levels by 2030 and allows states to establish their own plans to reduce electricity carbon intensity. In 2012, the U.S. finalized a new standard that will raise the average fuel economy in passenger vehicles to 54.5 miles per gallon for model year 2025, which is expected to reduce GHG emissions by 6 billion metric tons over the life of the program. The Climate Action Plan also includes other actions such as those to increase clean energy and improve energy efficiency in buildings and products.

In addition to these federal actions and programs, several U.S. states have developed carbon reduction policies and programs. Twenty states have set GHG emissions targets,[39] two carbon markets (California and RGGI) are operating in 10 states, 38 states have renewable portfolio standards or goals, and 27 states have energy efficiency resource standards or goals.[40]

FIGURE 6. GHG EMISSIONS PER CAPITA

$MTCO_2e$ PER PERSON (CARBON FOOTPRINT)



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Greenhouse gas emissions are from consumption of energy. Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 4. GREENHOUSE GAS EMISSIONS PER CAPITA RANKING

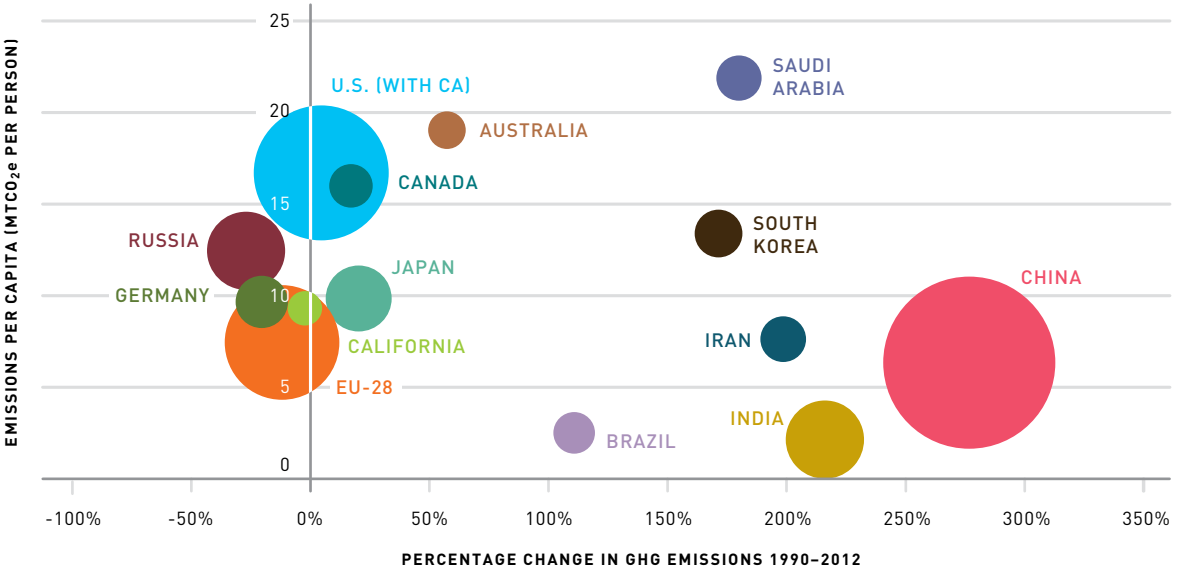
LOWEST EMISSIONS PER PERSON (CARBON FOOTPRINT) IN 2012 *see top 50 rankings on page 58*

RANK	REGION	$MTCO_2e$/PERSON	RANK AMONG OECD MEMBERS	REGION	$MTCO_2e$/PERSON
1	NIGERIA	0.51	1	TURKEY	3.72
2	PAKISTAN	0.77	2	MEXICO	3.87
3	PHILIPPINES	0.81	3	CHILE	4.78
4	VIETNAM	1.44	4	FRANCE	5.55
5	INDIA	1.52	5	ITALY	6.30
6	INDONESIA	1.83	6	SPAIN	6.64
7	EGYPT	2.47	7	EU-28	7.46
8	BRAZIL	2.51	8	POLAND	7.53
9	ALGERIA	3.58	9	UNITED KINGDOM	7.91
10	TURKEY	3.72	10	GREECE	8.13
20	CHINA	6.36	11	CZECH REPUBLIC	8.61
31	CALIFORNIA	9.16	12	CALIFORNIA	9.16
44	U.S. (WITH CALIFORNIA)	16.77	20	U.S. (WITH CALIFORNIA)	16.77

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of the top 50 in total GHG emissions from consumption of energy. There are 21 OECD members (including EU-28 and California) in the top 50 emitters. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 7. GREENHOUSE GAS EMISSIONS FROM CONSUMPTION OF ENERGY

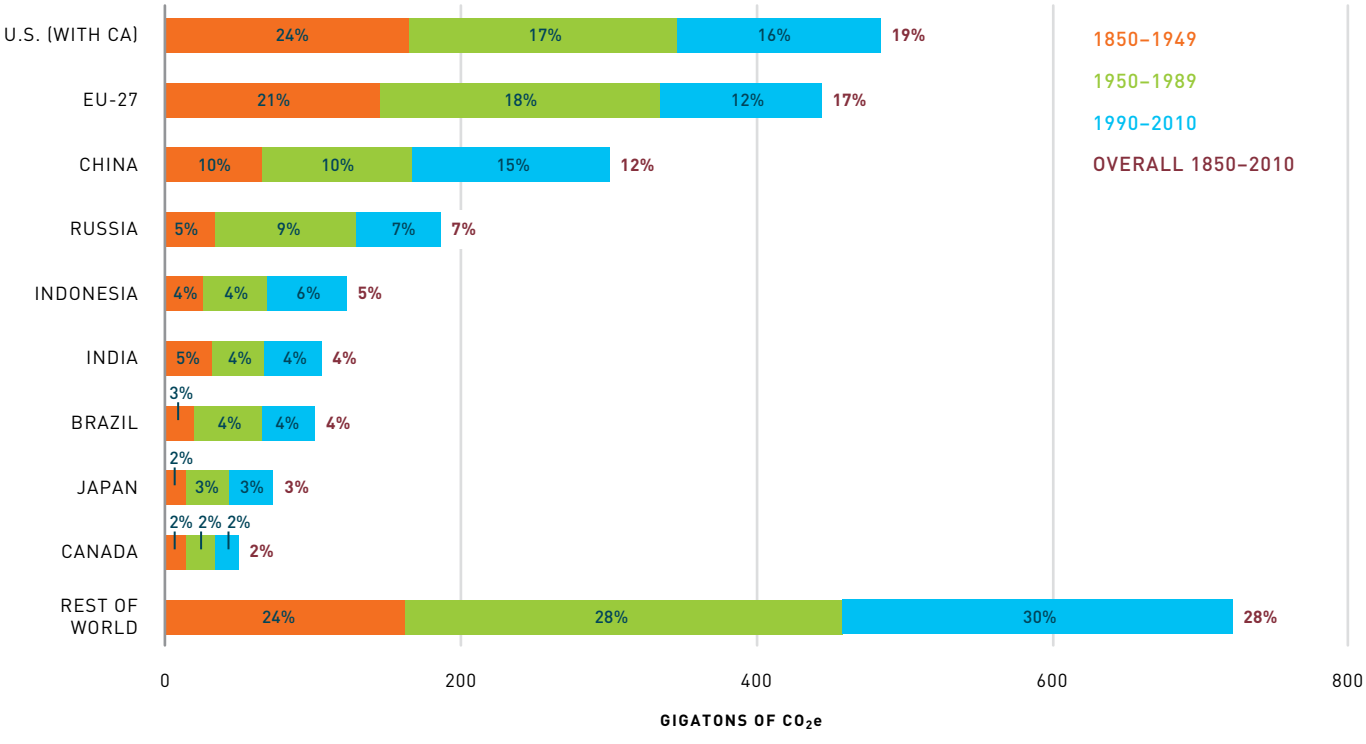
EMISSIONS PER CAPITA, TOTAL IN 2012, AND PERCENT CHANGE 1990–2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Size of the bubble is total greenhouse gas emissions from energy in 2012 (million $MTCO_2e$). Regions include top 12 GHG polluters plus Australia and California. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; The California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 8. TOTAL CUMULATIVE GREENHOUSE GAS EMISSIONS

BY TOP COUNTRIES AND PERCENT OF EMISSIONS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Data for full EU-28 and California breakout from the U.S. not available. Data Source: Den Elzen et al, PBL Netherlands Environmental Assessment Agency. Analysis: Den Elzen et al and Collaborative Economics. NEXT 10 / SF · CA · USA

and India doubled between 1990 and 2012. Despite this increase, India ranked fifth and China ranked 20th in lowest emissions per capita in 2012.

Nigeria had the lowest emissions per capita out of the top 50 polluters, and other developing or moderate-income countries took top spots. Out of the more developed countries (based on OECD membership), Turkey and Mexico had the best emissions per capita in 2012. California ranked in the middle at 31st in emissions per capita (12th compared to OECD members), and had nearly half the emissions per person as the U.S. overall in 2012 (Table 4).

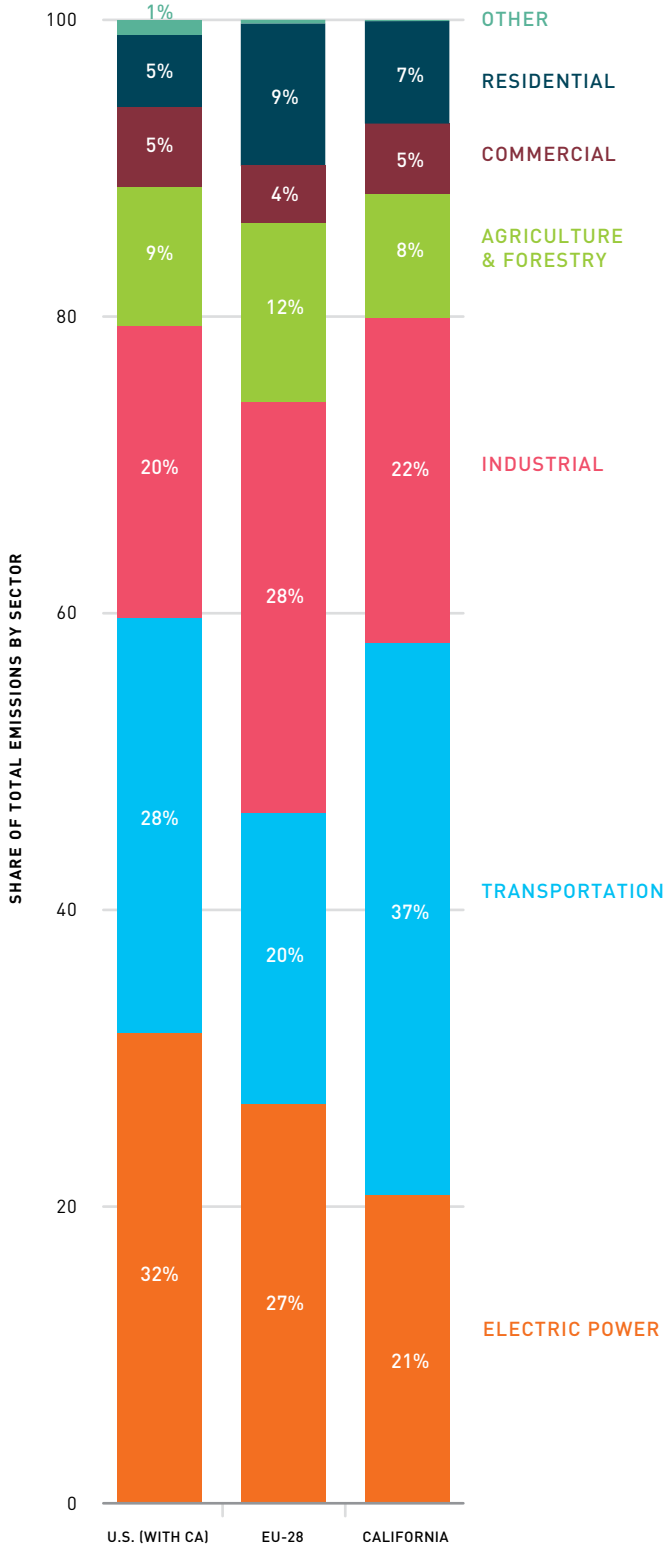
A summary of the changes in GHG emissions, as well as 2012 emissions and per capita levels, is shown in Figure 7. Many of the top GHG emitters increased emissions moderately since 1990, though there are a few outliers with large increases such as China, India, Saudi Arabia, and Iran. In 2012 emissions per capita, Saudi Arabia, Australia, and the U.S. are among the highest.

While China is currently the largest GHG polluter with 26 percent of global emissions, historically it accounts for a much smaller portion of cumulative emissions, representing 12 percent of total emissions from 1850–2010 (Figure 8). The U.S. was the largest single contributor of GHG emissions since 1850 (19%) and the EU was the second largest (17%) as the U.S. and EU consumed energy to develop their economies. This difference in current emissions compared to historical emissions is an important component of international climate negotiations, as countries do not want emissions reduction targets to limit economic growth.

The sources of GHG emissions vary by region, and therefore governments may focus on different GHG reduction policies and programs. For example, in 2012, California's largest share of emissions came from the transportation sector (37%), while in the EU-28 transportation emissions were only 20 percent of the total. The largest share of emissions in the U.S. was from the electric power sector, while the EU-28 had the most emissions from the industrial sector (Figure 9). Understanding these differences in emissions can help entities target reduction efforts at the top polluting sectors. For example, the U.S. Clean Power Plan proposed in June 2014 targets the electric power sector by cutting carbon emissions from power plants.

FIGURE 9. GREENHOUSE GAS EMISSIONS BY SECTOR

2012



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Air Resources Board; European Environment Agency; U.S. Environmental Protection Agency. Analysis: Collaborative Economics.
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CARBON PRICING MECHANISMS AROUND THE WORLD: TOOLS FOR REDUCING EMISSIONS

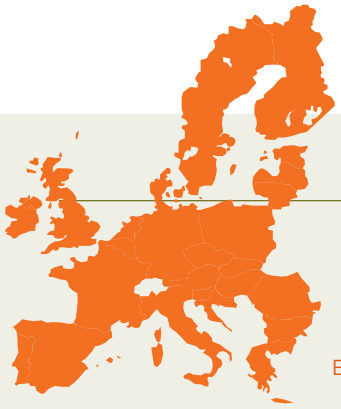
THE NEED FOR A CARBON PRICE

Carbon pricing mechanisms, designed to lower GHG emissions and meet carbon reduction goals, work by sending a price signal to businesses and other regulated entities to decrease emissions. They also provide flexibility, allowing entities cutting emissions to find the most efficient methods of reduction. Governments can learn from the experience of existing carbon pricing mechanisms and apply lessons to new climate commitments as we move into final negotiations at the UNFCCC 2015 in Paris.

OVERVIEW OF EXISTING CARBON PRICING MECHANISMS

What is a Carbon Pricing Mechanism?

Carbon pricing mechanisms are most commonly found in two categories, an emissions trading scheme (ETS) or a carbon tax. In an ETS, the government generally sets a limit or cap on emissions in a geographic area and issues "allowances," which give entities permission to emit units of emissions. Private entities may trade these allowances to match their emissions levels, and can achieve their limit of emissions by buying extra allowances or upgrading to more efficient technologies. A carbon tax is a fee to the entity based on the amount of emissions generated. Entities can pay the tax to emit or



COUNTRY HIGHLIGHTS

EUROPEAN UNION

#3 in GHG emissions from energy consumption

Emissions per capita = 7.46, GDP per capita = $35,100
Goal: GHG emissions 20% below 1990 levels by 2020

The EU has been a constant leader in international climate action and treaties. The EU's 28 countries comprise a developed region with the highest combined GDP in the world. While the EU is the third largest emitter of GHG emissions from energy consumption, its emissions per capita are less than half that of the U.S. (#25) and ranks well in terms of carbon intensity (#10). The EU was the second largest contributor of global GHG emissions between 1850 and 2010, accounting for 17 percent of the cumulative total.

The EU was one of the first to act on climate change, with a target set in 1991 to stabilize GHG emissions by 2000. EU leaders then set a target in 2007 and passed binding legislation in 2009 to reduce GHG emissions 20 percent below 1990 levels by the year 2020.[41] The region is already close to reaching this pledge early, with a 19 percent decrease of total GHG emissions below 1990 levels as of 2012.[42] In October 2014, the EU established a mid-term goal of cutting emissions 40 percent below 1990 levels by 2030, and also set a binding target of at least 27 percent renewable energy and 27 percent energy savings by 2030.[43] The region also has a long-term goal of cutting emissions 80–95 percent below 1990 levels by 2050. The EU has passed several pieces of complementary legislation to help achieve these goals. These laws apply to Member States based on their starting points and potential to contribute to the goal (e.g. renewable energy potential).

One of the key tools for reducing carbon in the EU is its ETS. The EU ETS launched in 2005 and was the first carbon market in the world. This system covers about 45 percent of the regions' emissions, and applies to more than 11,000 power stations and industrial plants in 31 countries, as well as commercial airlines within the EU. The EU ETS sets a limit on covered emissions and reduces the cap over time in order to decrease emissions. The EU ETS encountered several challenges in its early stages stemming from a surplus of allowances that was compounded by the economic recession. The European Commission is currently evaluating strategies to reform and improve stability of the ETS.[44]

implement carbon reduction strategies to avoid/reduce the fee. In addition, other pricing tools exist such as carbon offsets and results-based financing.

Where are Carbon Pricing Mechanisms?

While there is no international carbon market, about 60 carbon pricing mechanisms exist at the national, regional, and sub-national level. The Kyoto Protocol laid the foundation for a few international carbon pricing mechanisms, such as the Clean Development Mechanism that allows countries to implement a project to receive a certified emission reduction unit that can be traded, but these international tools have yet to gain significant traction and stability. In lieu of an international carbon market, 39 national and 20 sub-national entities implemented or have committed to implementing a carbon pricing mechanism. These entities combined cover about 12 percent of annual global GHG emissions.[13]

As of 2014, the World Bank estimates that current carbon pricing mechanisms apply to 12% of annual global emissions, or nearly 6,000 million $MTCO_2e$.

COUNTRY HIGHLIGHTS

INDIA

#4 in GHG emissions from energy consumption

Emissions per capita = 1.52, GDP per capita = $1,500
Pledge: GHG emissions intensity 20–25% below 2005 levels by 2020

India is the fourth-largest GHG producer in the world. The country's economy has grown four-fold from 1990 to 2012, while emissions levels have more than tripled. During this recent growth, emissions per capita remained low compared to top emitters (#5), though carbon intensity is relatively high (#42).

India is taking steps to reduce its dependence on fossil fuels, while continuing to grow the country's economy. It submitted a target in 2010 to the Copenhagen Accord to reduce the emissions intensity of its GDP by between 20 and 25 percent below 2005 levels by the year 2020.[45] India is the fourth-largest energy consumer in the world and increasingly relies on energy imports to meet its growing energy demand.[46] In 2008, India released the National Action Plan on Climate Change (NACC) outlining the country's eight national missions in the areas of solar power, energy efficiency, water, sustainable habitat, the Himalayan ecosystem, agriculture, land use, and climate change.[47] As a part of its National Mission on Enhanced Energy Efficiency, India enacted the Perform, Achieve, and Trade (PAT) program in 2010. PAT is a market-based mechanism to reduce emissions from energy-intensive sectors such as industrial facilities and power plants, and allows facilities to trade Energy Saving Certificates to meet reduction levels.[48] India recently announced ambitious targets to quadruple renewable energy generation capacity to 175 GW by 2022, including 100 GW of solar, building off of its national mission goals. This would be a dramatic increase from current levels; as of 2014 India had about 23 GW of wind, and as of 2013 the world had only 136.5 GW of solar capacity, less than 3 GW of which was in India. To support this initiative, the country will raise the tax duty on coal, and will look for foreign investment, as well as provide low-cost financing through national agencies.[49]

India has historically been reluctant to make absolute emissions reduction goals that may hinder economic growth. However, following a meeting in January 2015 between India's Prime Minister Modi and U.S. President Obama, the nation committed to working together on a strong agreement in global climate talks in Paris.[50]

TABLE 5. EXISTING OR EMERGING CARBON PRICING MECHANISMS

	NUMBER OF MECHANISMS
EMISSIONS TRADING SCHEMES	20
CARBON TAX	13
UNDECIDED SCHEME	26

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Includes regional, national, and sub-national carbon markets implemented or implementation scheduled; under consideration and yet to be chosen schemes are combined as Undecided since some entities are considering hybrids.
Data Source: World Bank, State and Trends of Carbon Pricing, 2014. Analysis: Collaborative Economics.
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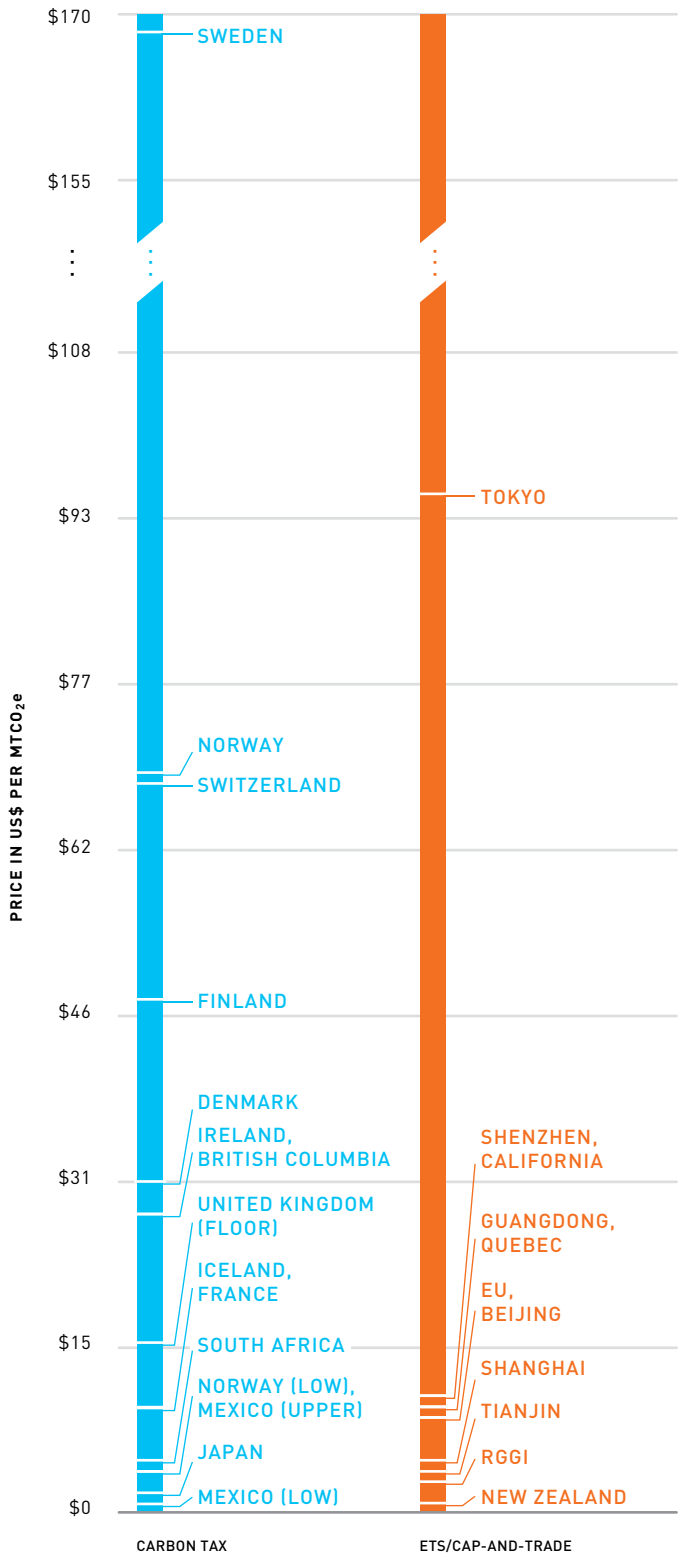
Of the 33 regions that already implemented or committed to carbon pricing mechanisms, 20 have an ETS and 13 have a carbon tax (Table 5). An additional 26 governments are considering an ETS, carbon tax, or hybrid of the two.

Carbon markets are gaining traction around the globe; eight new markets opened in 2013 (California, Quebec, Kazakhstan, and five Chinese pilots), two Chinese pilots launched in 2014, and South Korea launched a market in January 2015. The EU ETS launched in 2005 as the first major carbon market and is currently the largest single market in the world. China currently has seven pilot ETSs at the city/province level, and in November 2014 China announced plans to open a nationwide market in 2016.[14] California (U.S.) and Quebec (Canada) linked their respective cap-and-trade ETS programs with a joint auction of allowances in December 2014, making it the largest market in North America.[15] Other national and sub-national governments are exploring carbon pricing mechanisms, including Brazil, Chile, U.S. Pacific Northwest, Russia, Thailand, and Turkey.

In order to assess the true cost of various policies and of doing business, the cost of carbon and of adhering to carbon pricing programs are now also being factored into policy making and in business plans for individual companies. The U.S. government, for example, recently used the social cost of carbon to determine the cost to businesses and benefit to the public in regulations for energy efficiency standards and rebates.[16] Individual companies are increasingly integrating a price on carbon into their internal policies and programs, including large international corporations like Google Inc., Exxon Mobil Corp, BP, and Wal-Mart Stores, Inc.[17] Over 1,000 businesses have signaled their support for a carbon price.[18]

FIGURE 10. PRICE OF CARBON IN EXISTING SCHEMES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: World Bank, State and Trends of Carbon Pricing, 2014. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 6. SCOPE OF EMISSIONS TRADING SCHEMES

SECTOR	NUMBER OF ETS COVERED
INDUSTRY	14
POWER	14
BUILDINGS	7
TRANSPORT	5
AVIATION	2
WASTE	1
FORESTRY	1
AGRICULTURE	1

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Includes analysis of 19 regional, national, and sub-national existing emissions trading schemes. Data Source: World Bank, State and Trends of Carbon Pricing, 2014. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

THE PRICE OF CARBON

The price of carbon varies over time and across different markets. As of 2014, the price of carbon had a wide range around the world, though the majority of prices fell below US$35/MTCO$_2$ (Figure 10). The existing ETSs tended to have lower carbon prices than carbon tax mechanisms, with most clustered around US$12/MTCO$_2$.

SCOPE OF CARBON PRICING MECHANISMS

Carbon pricing mechanisms generally only apply to a portion of the total emissions in the geographic area and are used in coordination with other mitigation programs, such as renewable energy development. The types of pollution sources targeted for emissions vary and are generally tied to the government's carbon reduction goals and political constraints. For example, the Regional Greenhouse Gas Initiative (RGGI) in the U.S. Northeast covers only the power sector, while the EU covers power, industry, and aviation. California's cap-and-trade program applies to industry, the power sector, and transportation fuels.

Of the 19 existing ETS markets analyzed in a recent World Bank report,[19] the industry and power sectors are most commonly covered (targeted in about three-fourths of all existing ETS markets). Buildings and transport sectors are the next most common, targeted in about one-third of current ETS markets. Other sectors are less common and apply to only one or two existing markets, including Forestry, Aviation, Waste, and Agriculture (Table 6).

CARBON PRICING CHALLENGES AND TRADEOFFS

While the number of carbon pricing mechanisms grew in recent years, there have also been some technical and political challenges. Carbon pricing mechanisms are still in a relatively early stage of existence, and therefore some are working through growing pains. For example, the EU ETS encountered several challenges in its early stages stemming from a surplus of allowances, which lowered the carbon price to virtually zero. This surplus occurred because too many allowances were awarded initially at no cost, which was compounded by the economic downturn in the mid-to-late 2000s.[20] In spite of these initial challenges, the European Commission is taking action to reform the ETS and improve stability through actions such as postponing the auction of some allowances.[21] Other countries are backtracking on carbon pricing. In July 2014, Australia's Senate repealed the nation's carbon tax,[22] despite being one of the world's top emitters of GHGs and having one of the highest emissions per capita in the developed world.

A carbon tax and ETS have tradeoffs; a carbon tax has a known price for businesses but the expected emission reductions are not guaranteed, while the ETS has a known emissions limit but an uncertain price for businesses. The specific mechanism, however, is less important than the program design and how it addresses key elements such as which sectors are covered, price predictability, and effect on vulnerable firms. Both carbon pricing mechanisms have the potential to reduce emissions, although they create an additional cost to businesses in the short-term when compared to business as usual (no carbon price).

BENEFITS OF CARBON PRICING

Businesses covered by carbon pricing mechanisms are actively participating, indicating improved confidence in the programs. In November 2014, the California-Quebec joint auction sold all of its allowances,[23] and in December 2014 RGGI also sold out at its highest carbon price to date, though the carbon price is still relatively low.[24]

Carbon auctions and taxes are generating millions of dollars in new revenue for governments. Governments are using this revenue in a variety of ways, but most often a portion goes back into other carbon reduction programs. California, for example, established a process for spending cap-and-trade revenue that focuses on improving air quality and benefiting

disadvantaged communities. The state raised a total of $1.6 billion for its Greenhouse Gas Reduction Fund through its first ten quarterly auctions (2012–February 2015).[25] Costa Rica uses carbon tax revenue to pay landowners to grow trees, and British Columbia uses carbon tax money to cut other taxes. The nine U.S. states in RGGI agreed to spend at least 25 percent of their revenue for consumer benefit, though most states have spent far more than that in programs such as energy efficiency and energy bill assistance, stimulating local economies. This reinvestment in the RGGI states is expected to add $8 billion in net benefits and thousands of jobs to their local economies by 2020.[26]

With ten years of experience and lessons learned on carbon pricing mechanisms, there is a growing case for setting a price on carbon as an effective tool to reduce emissions. In addition, the revenue generated can benefit the economy through reinvestment.

Carbon pricing mechanisms cover a portion of the region's emissions. For example:

- **EU ETS** covers 45% (2,084 Million $MTCO_2e$) of regional emissions
- **RGGI** in the U.S. Northeast covers 20% (91 Million $MTCO_2e$) of the region's emissions
- As of January 2015, **California's** cap-and-trade program applies to 85% (almost 400 Million $MTCO_2e$) of the state's emissions

COUNTRY HIGHLIGHTS

RUSSIA

#5 in GHG emissions from energy consumption

Emissions per capita = 12.50, GDP per capita = $14,700
Goal: GHG emissions 15–25% below 1990 levels by 2020

Russia is the fifth largest producer of energy-related GHG emissions in the world. Total GHG levels decreased 27 percent between 1990 and 2012, largely due to the collapse of the Soviet Union in 1991, but emissions have been increasing in recent years. Russia ranks poorly in terms of emissions per capita (#36) and in carbon intensity (#44).

In the Copenhagen Accord, Russia pledged to reduce emission levels by 15 to 25 percent below 1990 levels by the year 2020 and is on track to do so. However, this reduction is an increase from 2010 levels, and emissions are projected to continue rising until 2030.[51] Russia's economy is dependent on fossil fuels, with oil and gas revenues accounting for 50 percent of its federal budget revenues. Russia is the second-largest producer of dry natural gas and has high emissions due to flaring natural gas.[52]

Russia has implemented legislation to increase renewable energy and improve energy intensity. In 2009, Russia set a target for 4.5 percent of electricity from renewable energy by 2020, and has capacity-based targets for adding wind, solar, and small-scale hydro power.[53] Russia is one of the first nations to adopt a capacity market based renewable energy policy, which is expected to allow the country greater control of the costs of renewable energy.[54] Russia also adopted an energy efficiency target in 2009 to reduce energy intensity by 44 percent between 2005 and 2020.[55]

ENERGY EFFICIENCY

WHY IS IT IMPORTANT?

Energy use is the primary source of global GHG emissions, therefore improving energy efficiency is an important GHG reduction strategy. Energy efficiency enables consumers to optimize their energy use and consume less energy for the same or higher level of service. Indicators that measure change in electricity and overall energy consumption, while factoring in changes in population and the economy, can show how regions are progressing towards making energy more affordable and efficient while reducing GHG emissions.

ENERGY EFFICIENCY INDICATORS

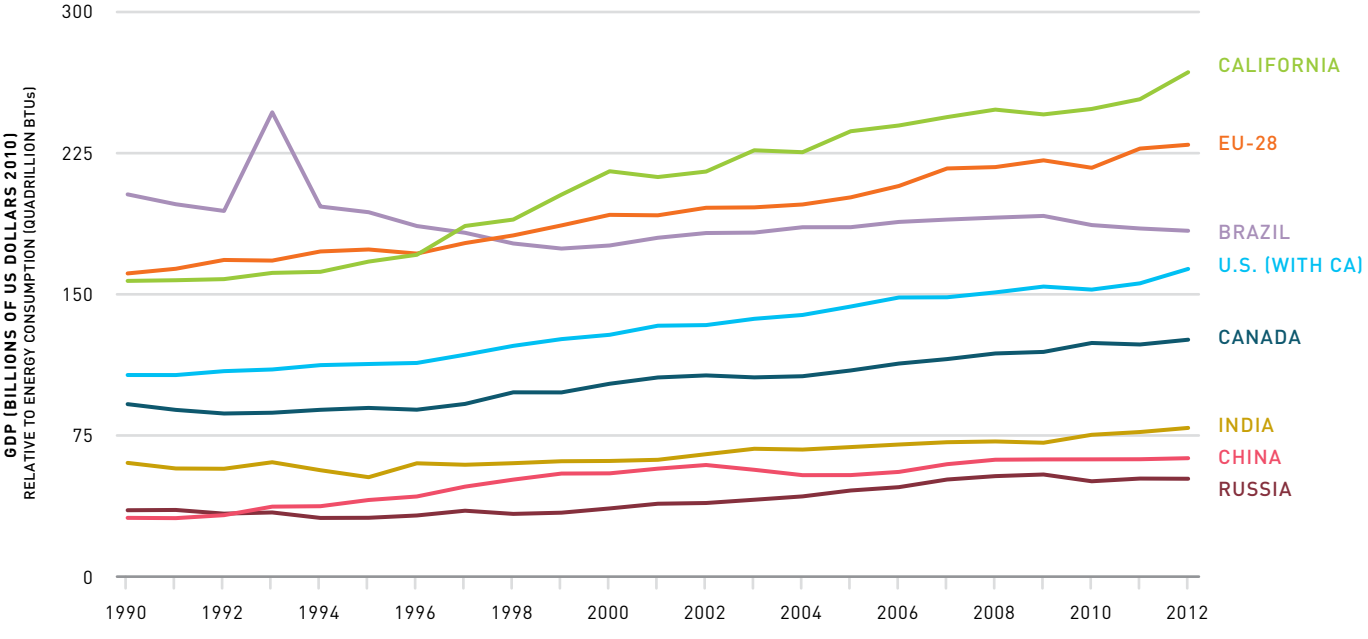
California has been at the forefront of energy efficiency policy and business activity since the 1970s. This early start is bearing results as California continues to grow its GDP faster than its energy use, leading to improved energy productivity. Energy productivity measures the GDP produced (economic output) for each unit of energy consumed (resource input). In 2012, California generated nearly 64 percent more GDP for every unit of energy consumed compared to the U.S. as a whole (Figure 11). California had one of the best energy productivity rates among the top polluters and had a 70 percent improvement between 1990 and 2012. The EU-28 also had high energy productivity and improved 53 percent between 1990 and 2012. China had the largest improvement with a 101 percent increase over the same time period, though it still has relatively poor energy productivity.

Russia has the worst energy productivity among the top five polluters (ranking 47th out of the top 50), producing less than a quarter of the amount of GDP per unit of energy compared to California. Among the top 50 polluters, Nigeria had the highest energy productivity, followed by Italy, Japan, the United Kingdom, and California (Table 7).

Energy consumption per person improved over time in most of the developed countries, while most of the low- to moderate-income countries increased. California had the greatest improvement (-19.5%) between 1990 and 2012 among the top 20 polluters (Figure 12). California outperforms the U.S. as a whole, with 33 percent less per capita energy consumption in 2012, though it is higher than the EU-28. Canada has one of the highest per capita energy consumption rates, while India has one of the lowest despite its recent increase. China more than tripled its energy consumption per person between 1990 and 2012, though it is still lower than most developed countries.

FIGURE 11. ENERGY PRODUCTIVITY

GDP RELATIVE TO TOTAL ENERGY CONSUMPTION IN BTUs



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 7. ENERGY PRODUCTIVITY RANKING

HIGHEST PRODUCTIVITY IN 2012 *see top 50 rankings on page 60*

RANK	REGION	GDP (BILLION US$ 2010) / QUADRILLION BTU
1	NIGERIA	453.0
2	ITALY	281.2
3	JAPAN	273.1
4	UNITED KINGDOM	269.8
5	CALIFORNIA	268.2
6	GERMANY	255.5
7	FRANCE	244.9
8	ISRAEL	239.9
9	EU-28	229.6
10	SPAIN	226.2
19	U.S. (WITH CALIFORNIA)	163.7
44	CHINA	63.1

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of the top 50 in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; U.S. Bureau of Economic Analysis. Analysis: Collaborative Economics.
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TABLE 8. ENERGY PER CAPITA RANKING

LOWEST TOTAL ENERGY CONSUMPTION PER PERSON IN 2012
see top 50 rankings on page 62

RANK	REGION	MILLION BTU / PERSON	1990–2012 % CHANGE
1	NIGERIA	5.4	-25.9%
2	PHILIPPINES	12.6	20.9%
3	PAKISTAN	13.9	40.3%
4	INDIA	19.8	111.1%
5	VIETNAM	25.4	509.2%
6	INDONESIA	25.8	103.2%
7	EGYPT	42.3	62.3%
8	IRAQ	52.1	3.0%
9	ALGERIA	59.8	21.0%
10	BRAZIL	60.7	57.6%
16	CHINA	82.3	250.4%
37	CALIFORNIA	202.8	-19.5%
44	U.S. (WITH CALIFORNIA)	302.5	-10.4%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is among the top 50 regions in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; California Department of Finance; USDA Economic Research Service. Analysis: Collaborative Economics.
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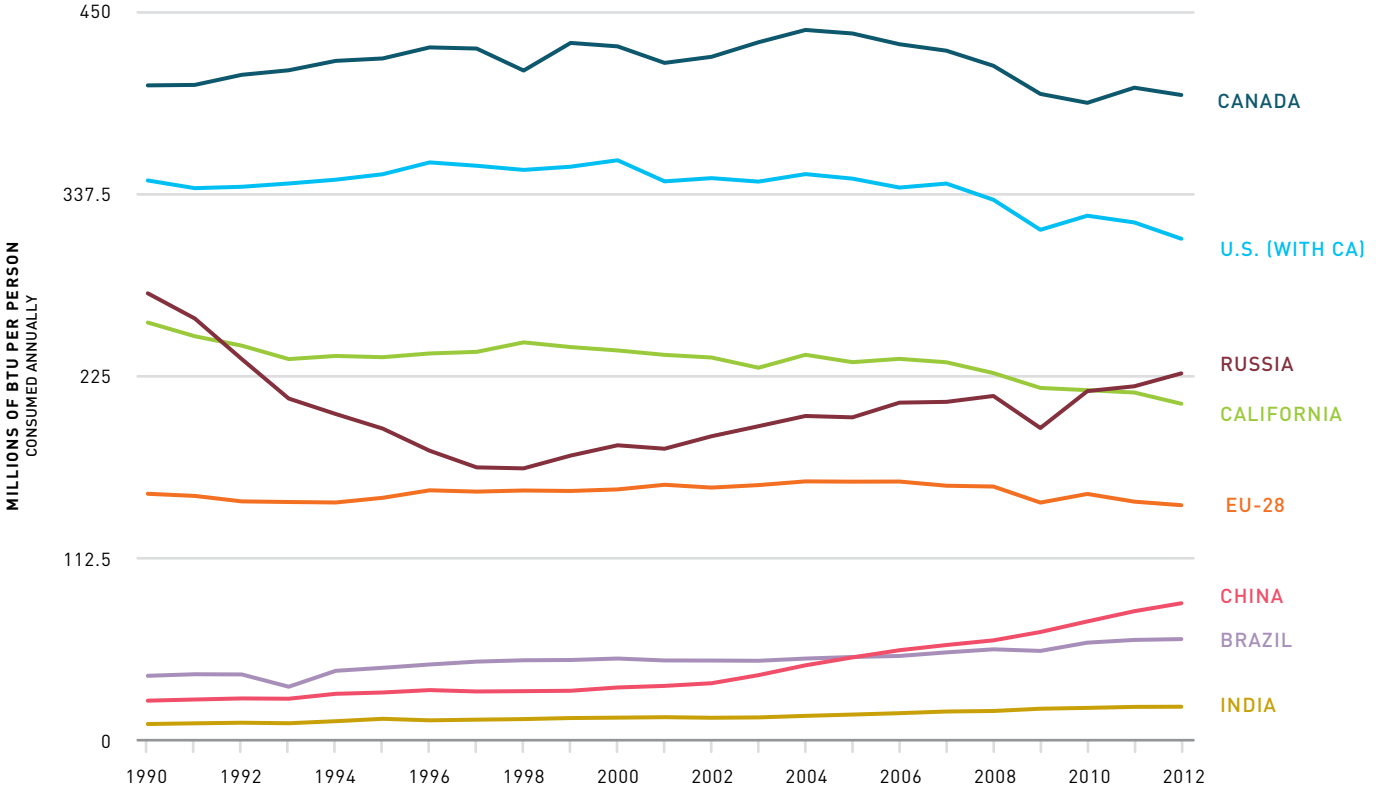
FIGURE 12. TOTAL ENERGY CONSUMPTION PER CAPITA



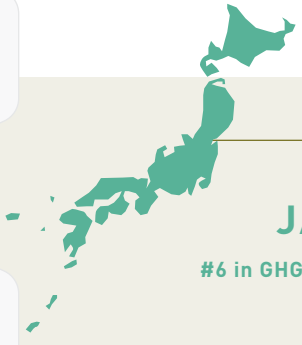
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration; U.S. Bureau of Economic Analysis; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

Nigeria achieved the best rank among the top 50 polluters with the lowest energy consumption per capita in 2012, followed by the Philippines, and other low- to moderate-income countries (Table 8). The U.S. ranks among the worst countries in energy consumption per capita at 44th, while California also ranked poorly at 37th.

Electricity is a key part of total energy consumption, and is the most visible energy source to the average person. Electricity consumption per person changed more dramatically than total energy per capita over time for most low- to moderate-income countries. China's per capita electricity consumption rate was nearly seven times higher in 2012 compared to 1990, while India's nearly tripled over the same time period (Figure 13). California improved with a 4 percent decrease in electricity use per person between 1990 and 2012, while the U.S. and EU-28 both increased (+8% and +17% respectively). Nigeria had the lowest electricity per capita in 2012, followed by Pakistan, with California ranking relatively low at 37th (Table 9).

Coal is a common fuel source for electricity, but also has the highest carbon content of all fossil fuels, resulting in high GHG emissions during combustion. Coal consumption has varied since 1990, with some countries reducing consumption to meet air quality and GHG reduction goals, while others increased consumption. Australia has one of the highest per capita coal consumption rates, with 6.8 short tons consumed per person in 2012 (Figure 14). China tripled its per capita coal consumption between 1990 and 2012, though is still lower than South Korea and Germany. California has only a small portion of energy from coal, and therefore has low per capita coal consumption.

In total coal consumption, China far surpasses other countries with 4.15 billion short tons of coal consumed in 2012, more than four times the next largest consumer, the U.S. (Table 10).



COUNTRY HIGHLIGHTS

JAPAN

#6 in GHG emissions from energy consumption

Emissions per capita = 9.89, GDP per capita = $38,700
Pledge: GHG emissions 3.8% below 2005 levels by 2020

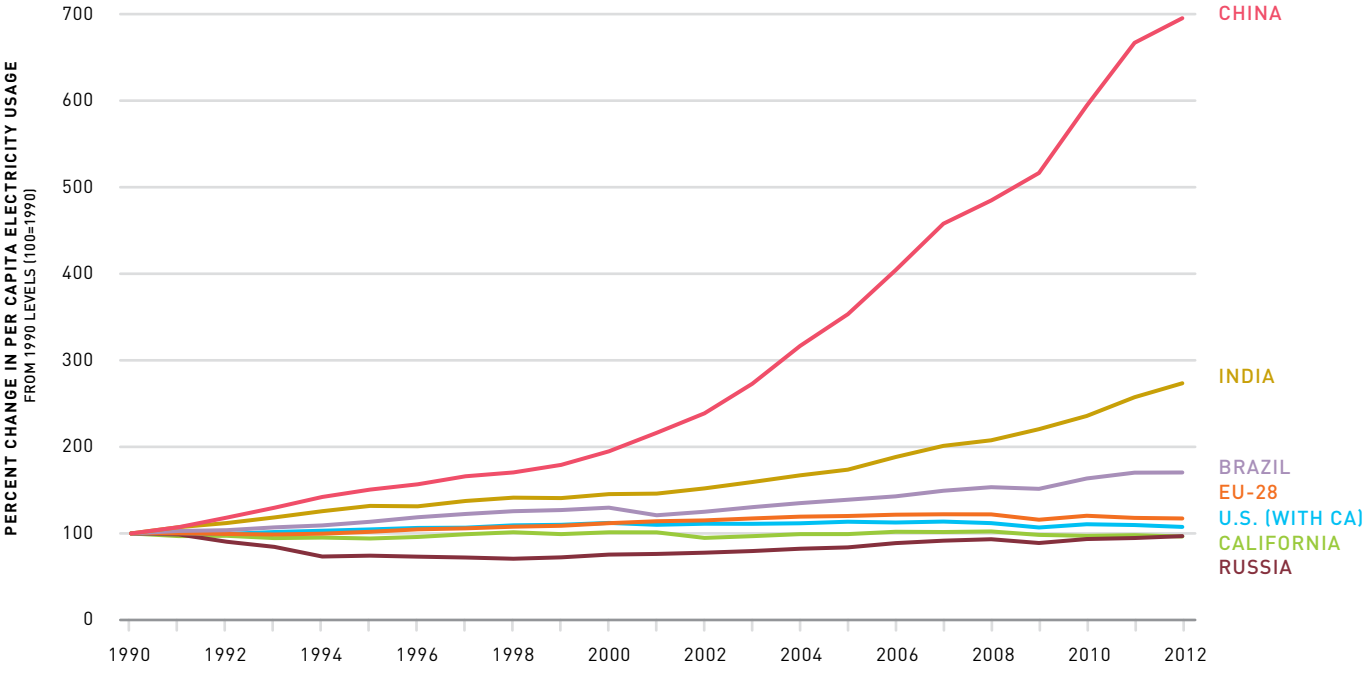
Boasting the third largest economy in the world, Japan's energy-related emissions levels increased 20 percent since 1990. The country's emissions per capita ranking (#34) is relatively high, but it has relatively low carbon intensity (#7).

While Japan was an early leader in international climate action, it has recently diluted its carbon reduction commitments. In November 2013, Japan reversed its original 2009 Copenhagen pledge to reduce emissions 25 percent below 1990 levels by the year 2020, scaling back to a 3.8 percent reduction below 2005 levels by 2020 (equivalent to a 5 percent increase from 1990 by 2020).[56] This revision is partly attributed to the 2011 earthquake that caused a disaster at the Fukushima nuclear power plant. Prior to 2011, nuclear energy accounted for 26 percent of Japan's power, though the share fell to 1 percent in 2012 as nearly all of the generators were shut down. This nuclear capacity was replaced primarily with oil and natural gas. Japan's 2014 Strategic Energy Plan lays out a plan for reintroducing nuclear energy as a key source of baseload power, as well as increasing energy efficiency measures and accelerating renewable energy development.[57] The 2010 Basic Energy Plan set a goal of sourcing 12.5 percent of electricity from renewables by 2020, and in 2012 the government passed a feed-in-tariff program to support this goal.[58] In 2012, 5 percent of Japan's electricity came from renewable sources.[59]

Japan has experimented with carbon pricing mechanisms, though does not yet have plans for a national mandatory program. Its past efforts include a voluntary emissions trading scheme that ended in 2012 and various carbon offset programs. At the sub-national level, the country has three emissions trading schemes that cover 8 percent of its total GHG emissions. Tokyo and Saitama's sub-national programs are mandatory, and Kyoto's program is voluntary with non-binding targets.[60]

FIGURE 13. ELECTRICITY CONSUMPTION PER CAPITA

RELATIVE TO 1990



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: U.S. Energy Information Administration; USDA Economic Research Service; California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

Preliminary data shows coal demand is slowing in China, with a 2.9 percent decrease in 2014 compared to 2013. The top consumers of coal are often also the top producers of coal, as countries often use domestic energy resources. Japan and South Korea, however, are both large consumers of coal imported from other countries and have little to no domestic production.

→ Recent Coal-Related Policies

Many countries and regions are taking steps to reduce coal consumption. A few recent actions include:

- The U.S.'s proposed Clean Power Plan is expected to shift electricity generation away from coal and towards cleaner sources such as natural gas and renewables.
- India doubled its tax on coal mined or imported into the country to finance clean energy projects and reduce reliance on coal.

TABLE 9. ELECTRICITY PER CAPITA RANKING

LOWEST ELECTRICITY CONSUMPTION PER PERSON IN 2012

see top 50 rankings on page 64

RANK	REGION	THOUSANDS OF kWh/PERSON	1990–2012 % CHANGE
1	NIGERIA	0.1	77%
2	PAKISTAN	0.4	57%
3	PHILIPPINES	0.6	79%
4	INDONESIA	0.7	218%
5	INDIA	0.7	174%
6	ALGERIA	1.1	127%
7	VIETNAM	1.2	1170%
8	IRAQ	1.4	34%
9	UZBEKISTAN	1.6	-36%
10	EGYPT	1.6	139%
18	CHINA	3.3	595%
37	CALIFORNIA	6.9	-4%
46	U.S. (WITH CALIFORNIA)	12.2	8%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is among the top 50 regions in total GHG emissions from consumption of energy. Data Source: U.S. Energy Information Administration; California Department of Finance; USDA Economic Research Service. Analysis: Collaborative Economics.
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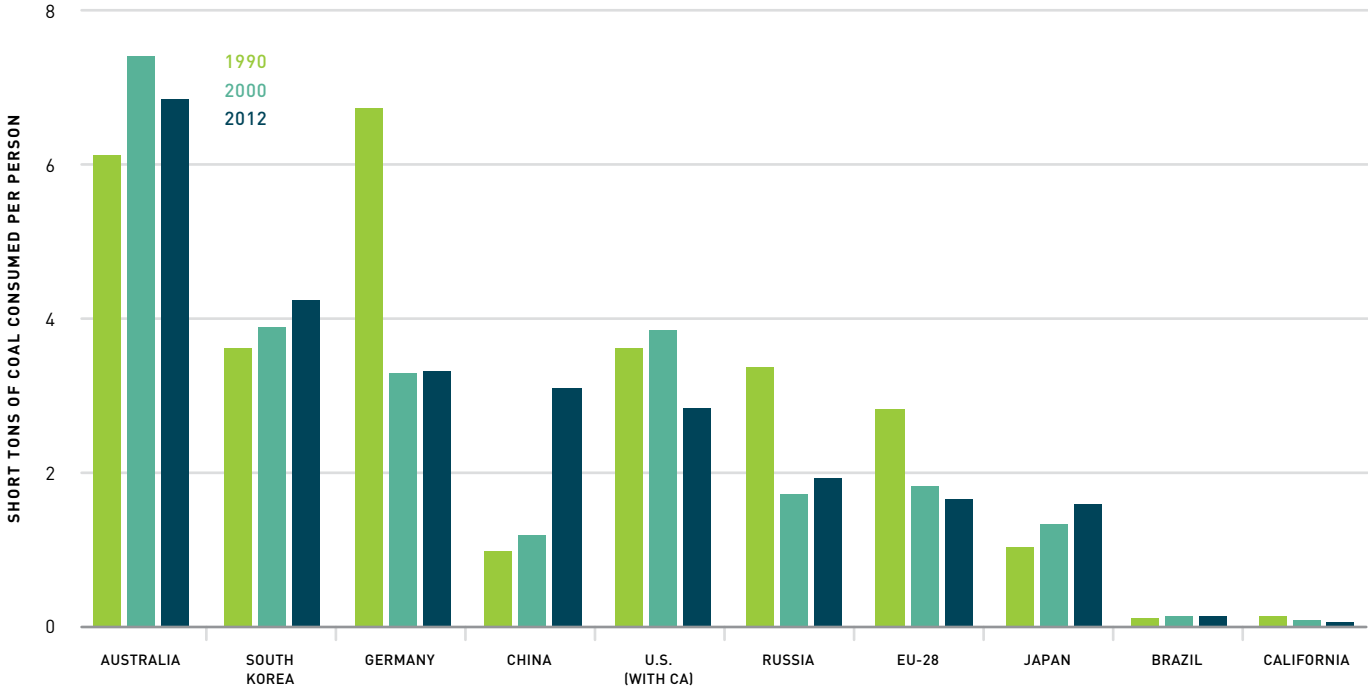
FIGURE 14. COAL CONSUMPTION PER CAPITA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration; USDA Economic Research Service. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 10. TOP COAL CONSUMERS AND PRODUCERS

IN THOUSANDS OF SHORT TONS OF COAL, 2012

CONSUMPTION RANK	PRODUCTION RANK	REGION	TOTAL CONSUMPTION	TOTAL PRODUCTION
1	1	CHINA	4,150,656	4,025,377
2	2	U.S. (WITH CALIFORNIA)	889,185	1,016,458
3	4	EU-28	839,094	619,772
4	3	INDIA	744,519	649,644
5	6	RUSSIA	274,200	390,152
6	8	GERMANY	269,435	217,144
7	7	SOUTH AFRICA	206,328	285,832
8	N/A	JAPAN	201,932	N/A
9	5	AUSTRALIA	150,605	463,783
10	9	POLAND	146,666	158,197
11	42	SOUTH KOREA	137,599	2,306
12	12	TURKEY	108,397	76,622
13	10	KAZAKHSTAN	104,787	138,918
63	N/A	CALIFORNIA	1,863	N/A

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: California and Japan did not produce coal in 2012. Data Source: U.S. Energy Information Administration. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

RENEWABLE ENERGY

WHY IS IT IMPORTANT?

Renewable energy is an unlimited source of energy that leverages replenishable natural resources, and produces no net emissions when compared to fossil fuel energy. Therefore, renewable energy offers a way to increase or maintain an energy supply while reducing GHG emissions and many environmental impacts from energy use. Indicators that track trends in renewable energy illustrate the global shift to a cleaner energy supply.

RENEWABLE ENERGY INDICATORS

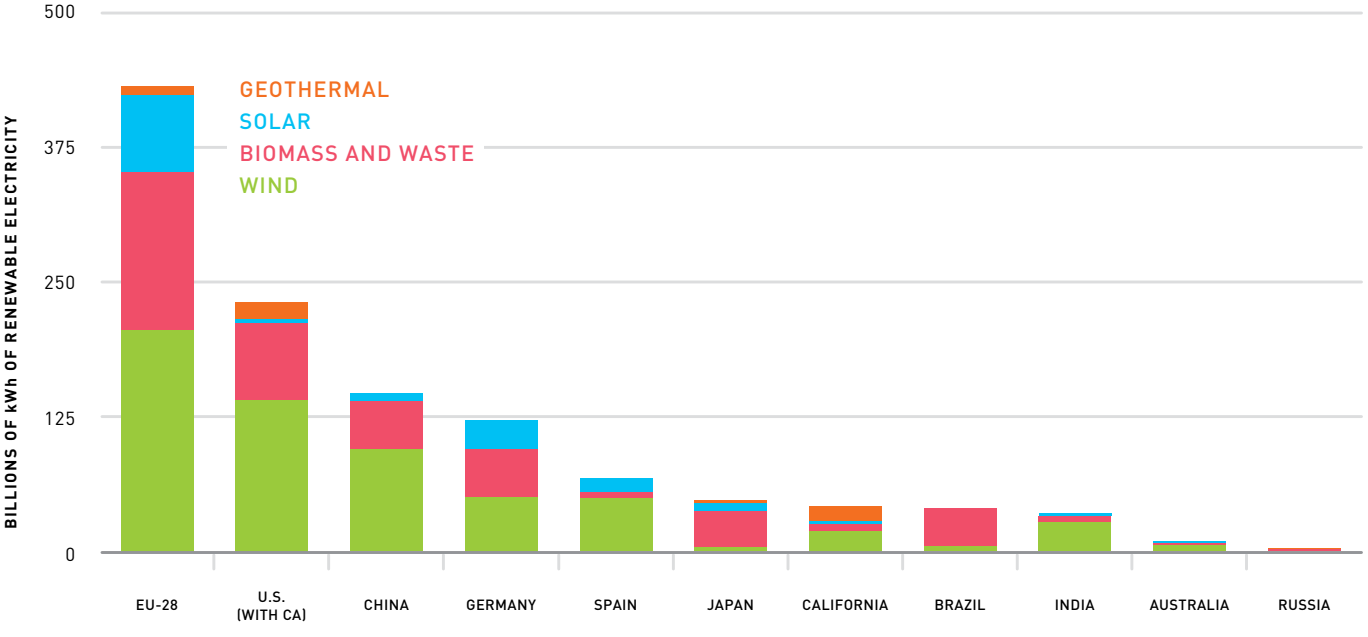
Renewable energy is increasingly affordable compared to fossil fuel sources, contributing to increased installations and investor interest around the world. In the U.S., for example, onshore wind energy is already cost competitive with conventional fossil fuel generation,[27] and utility scale solar energy is expected to be the same price or less than average electricity rates in more than half of the states in 2016, even if current tax credits decrease.[28] In addition, energy storage technology is improving, which helps enable increased renewable energy penetration. Supportive policies, such as California's mandate for 1.3 Gigawatts of energy storage by 2020, are also helping grow the global market for energy storage installations.

The EU-28 was the global leader in total renewable electricity generation in 2012, producing 430 billion kWh from renewable sources (Figure 15). Wind accounted for 48 percent of the EU-28's renewable electricity portfolio, followed by biomass and waste (34%) and solar (17%). The U.S. generated roughly half the EU-28's levels of renewable electricity in 2012, with wind and biomass and waste accounting for most of the total. China ranked third with 147 billion kWh from renewable sources in 2012, primarily from wind and biomass and waste. Germany followed China, with wind as the leading renewable energy source (42%) and a relatively large amount of solar (22%). Germany was the highest of any single country for solar energy generation in 2012, followed by Spain. Eighty-seven percent of Brazil's renewable electricity was from biomass and waste sources, the fourth highest generation from this source of any country in the world. In California, 46 percent of renewable electricity generated came from wind, followed by geothermal (31%) and solar (17%).

In 2012, Germany (part of the EU-28) generated 21 percent of electricity from renewable sources, rising from 13 percent in 2008 (Figure 16). California's share of electricity from

FIGURE 15. TOTAL RENEWABLE ELECTRICITY GENERATION BY SOURCE, 2012

*see top 50 rankings on page 66



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows.
Data Source: U.S. Energy Information Administration; California Energy Commission. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

renewables also surged in 2012 to 15 percent. More recently, Germany generated 27 percent of electricity from renewable sources in the first half of 2014, while California jumped to 23 percent. The EU-28 and Brazil followed with 14 percent and 7 percent of total electricity from renewables, respectively. In 2012, China generated 3 percent from renewable sources, a rapid increase from 2008 levels, and is expected to jump in 2013–2014 with large new wind and solar installations in more recent years. Russia maintained low levels of 0.3 percent.

In addition to the increasing deployment of renewable electricity in large economies over the past decade, there are many smaller economies using renewable technologies as an integral part of national electricity generation. Denmark, Belize, and Portugal led the world in 2012 in the share of electricity generated from renewable sources, equaling 51 percent, 47 percent, and 32 percent, respectively (Table 11). Iceland also generated high levels from renewables in relation to total electricity, largely drawing on geothermal energy.

Among the top 50 GHG polluters, countries in the EU-28 dominated the best rankings in share of electricity generated from renewable sources (Table 12). Spain ranked first, sourcing 24 percent of electricity from renewables in 2012, largely from its wind energy capacity. The only non-European regions in the top 10 were California, the Philippines, and the United States. Both California and the Philippines sourced 15 percent of their annual electricity from renewables in 2012 drawing on a mix of geothermal, wind, and solar technologies. The Philippines' robust renewable electricity generation is driven by strong public policies, including a feed-in tariff and renewable portfolio standard, stemming from the cost and challenge of transporting fossil fuels across the archipelago.[29]

The world had a total of 370,000 MW (370 Gigawatts) of wind energy capacity installed by the end of 2014 (Figure 17).

COUNTRY HIGHLIGHTS

GERMANY

#7 in GHG emissions from energy consumption

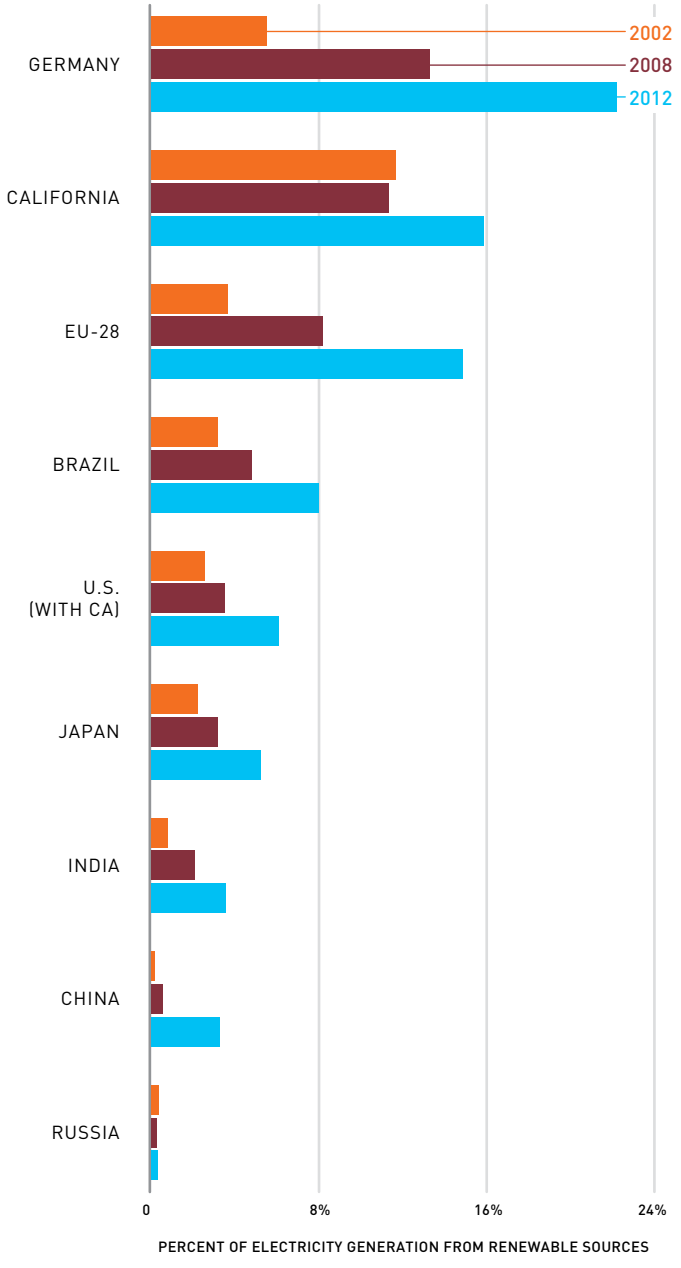
Emissions per capita = 9.70, GDP per capita = $46,100
Goal: GHG emissions 40% below 1990 levels by 2020

With the fourth largest economy in the world, Germany ranks relatively well in carbon intensity (#9), though not as well in terms of emissions per person (#33). It has made progress in lowering energy-related emissions, with levels falling 20 percent between 1990 and 2012.

Germany has developed aggressive policies to shift energy production towards renewable sources and lower emissions. In 2010, Germany adopted the Energy Concept, a strategic plan outlining how to achieve a 40 percent reduction in GHG emissions relative to 1990 levels by 2020 and an 80–90 percent reduction by 2050. Germany is a world leader in non-hydro renewable electricity production, and is the largest European producer of solar and wind.[61] However, petroleum and other liquids comprise 37 percent of the country's primary energy consumption, and Germany was the eighth largest producer of coal in 2012.

To reduce Germany's fossil fuel use, the Energy Concept established goals of 20 percent reduction of primary energy consumption relative to 2008 by 2020 and an increase in renewable energy.[62] In 2012, Germany was the fifth-largest in nuclear energy generation, though after the 2011 Fukushima nuclear plant accident in Japan, Germany closed a number of their nuclear power plants and plans to close the remaining plants by 2022. To replace this lost generation, Germany increased coal consumption for electricity production.[63] This has left Germans with one of the highest energy bills in Europe and greatly affected the country's ability to reach their 2020 goal.[64] At the end of 2014, Germany announced a new plan to reverse its increasing emissions, including additional emissions cuts for electricity producers and car makers, and energy efficiency incentives.[65]

FIGURE 16. PERCENT OF TOTAL ELECTRICITY GENERATION FROM RENEWABLE SOURCES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Renewables do not include large hydro. Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: California Energy Commission; U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 11. SHARE OF ELECTRICITY FROM RENEWABLE SOURCES

LARGEST SHARE OF RENEWABLES OUT OF ALL COUNTRIES, 2012

RANK	REGION	% ELECTRICITY FROM RENEWABLES	RENEWABLE GENERATION IN BILLIONS OF kWh
1	DENMARK	51%	14.7
2	BELIZE	47%	0.2
3	PORTUGAL	32%	13.7
4	NICARAGUA	31%	1.3
5	EL SALVADOR	31%	1.9
6	ICELAND	30%	5.2
7	KENYA	24%	1.9
8	SPAIN	24%	66.4
9	COSTA RICA	21%	2.1
10	GERMANY	21%	121.7

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank out of all countries. Renewables do not include large hydro. Data Source: California Energy Commission, U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 12. SHARE OF ELECTRICITY FROM RENEWABLE SOURCES

LARGEST SHARE OF RENEWABLES OUT OF TOP 50 POLLUTERS, 2012

*see top 50 rankings on page 68

RANK	REGION	% ELECTRICITY FROM RENEWABLES	RENEWABLE GENERATION IN BILLIONS OF kWh
1	SPAIN	24%	66.4
2	GERMANY	21%	121.7
3	ITALY	18%	50.3
4	CALIFORNIA	15%	46.5
5	PHILIPPINES	15%	10.5
6	EU-28	14%	430.1
7	BELGIUM	13%	10.1
8	NETHERLANDS	13%	12.0
9	UNITED KINGDOM	10%	35.0
10	GREECE	10%	5.7
15	U.S. (WITH CALIFORNIA)	6%	232.1
26	CHINA	3%	147.2

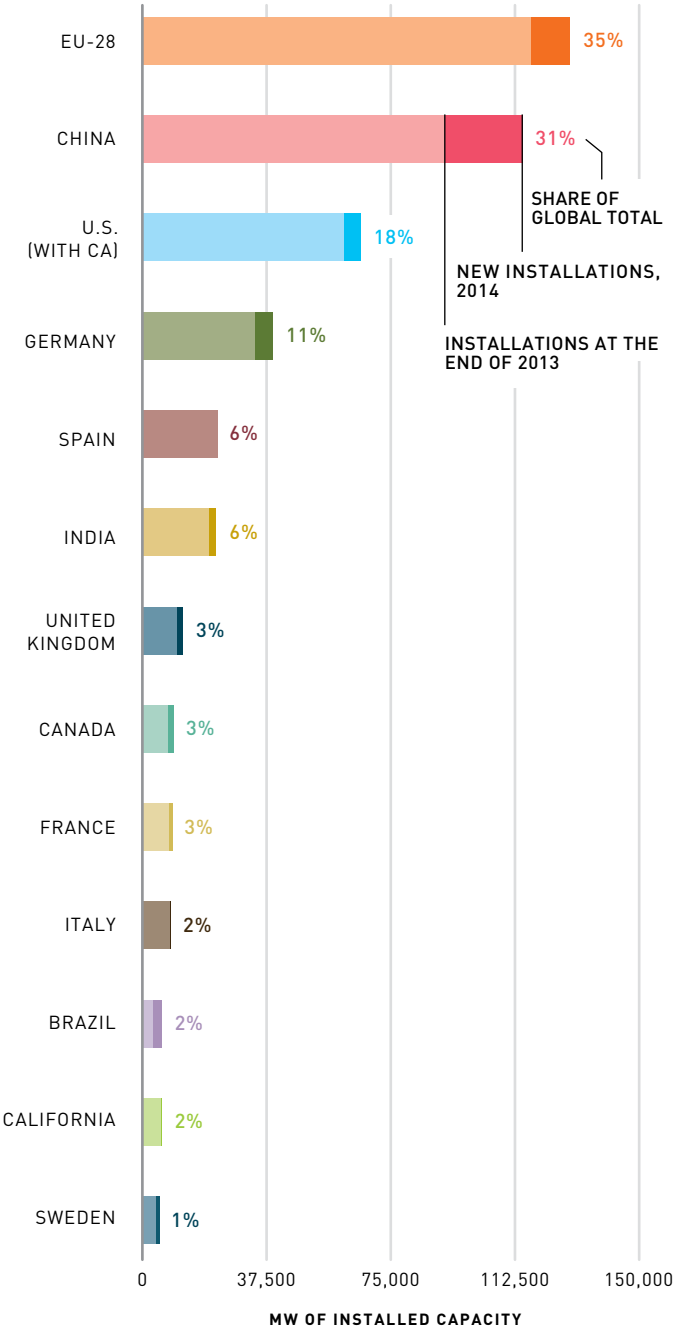
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is among the top 50 regions in total GHG emissions from consumption of energy. Renewables do not include large hydro. Data Source: California Energy Commission, U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

The EU-28 had the most total wind energy installations, with 35 percent of the global total. China had the most new installations in 2014, and ranked second in total wind installations, followed by the United States. Renewable energy installations show the potential generation capacity, though the actual amount generated depends on the resource area and technology used.

Cumulative global solar energy capacity reached 136.5 Gigawatts in 2013 (Figure 18). Germany, China, and Italy comprise more than half of the world's total installed solar capacity, with 25 percent in Germany alone. Japan has the fourth largest installed solar capacity, followed by the United States. This share may

FIGURE 17. WIND ENERGY

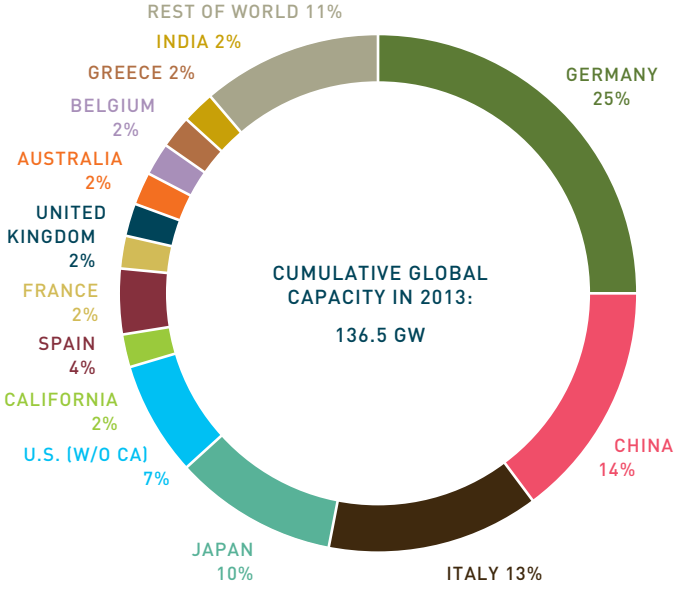
INSTALLATIONS AND SHARE OF GLOBAL CAPACITY, 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: The rest of the world combined has 22,061 MW of installed capacity, or about 6% of the global total. Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: American Wind Energy Association and Global Wind Energy Council. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 18. SOLAR ENERGY

CUMULATIVE INSTALLED CAPACITY, 2013



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Total may not add to 100% due to rounding. Data Source: Solar Energy Industries Association and International Energy Agency - Photovoltaic Power Systems Programme. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

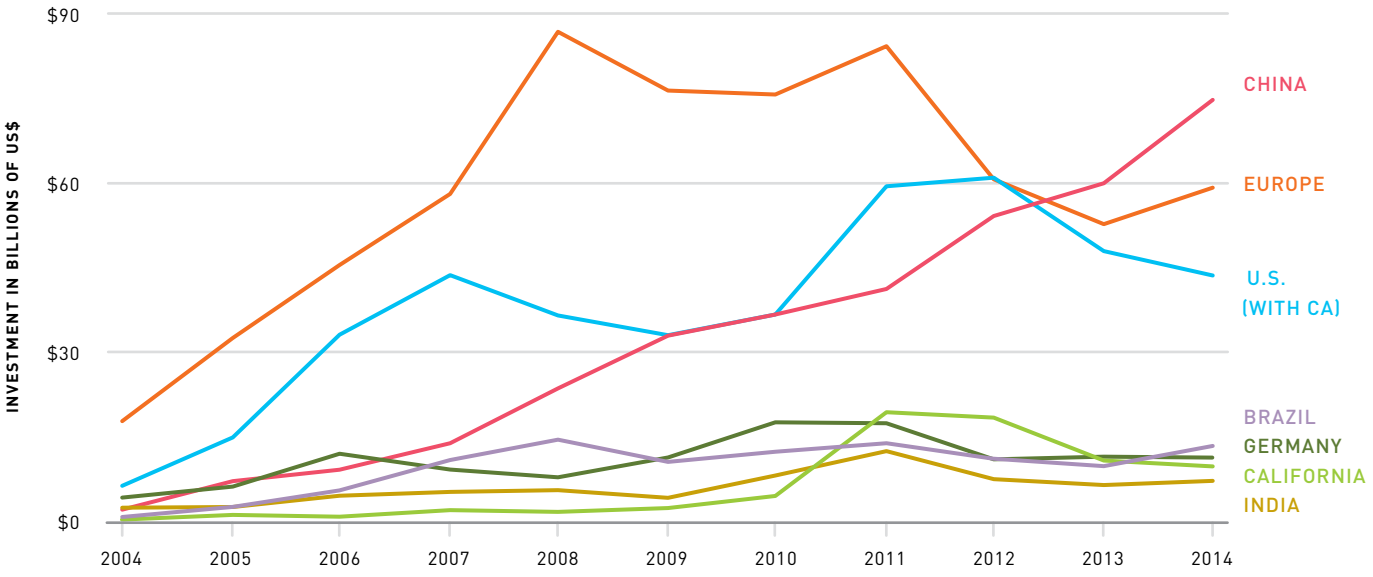
shift in coming years, as China installed the most new solar energy in 2013 and Germany's installations slowed.

Large companies are recognizing the investment potential in renewable energy. For example, in February 2015, Citigroup Inc. announced plans to lend, invest, and facilitate $100 billion worth of deals by 2025 for climate projects such as renewable energy. This investment is on top of the $50 billion invested between 2007 and 2013.[30]

Project financing, from sources such as investment banks and corporations, is a key investment mechanism for deploying utility scale renewable energy, and represents a leading indicator of future renewable capacity. Over the past decade, project financing for renewable energy projects in China has sharply and consistently increased; in 2014 Chinese investment levels were 32 times higher than 2004 levels (Figure 19). In contrast, after a steep ramp-up between 2004 and 2008, project financing in both Europe and the U.S. has moderated and fell behind Chinese investment levels in 2013. In 2014, project financing in Europe and the U.S. was $59.7 and $44 billion, respectively. Project financing in Brazil surpassed that of Germany in 2014 for the first time in six years, rising to $13.6 billion.

FIGURE 19. RENEWABLE ENERGY PROJECT FINANCING

TOTAL INVESTMENT BY REGION



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amounts in nominal US$ (not adjusted for inflation). Data includes New Build, Refinance, and Acquisition asset finance investment only for projects in segments: Biofuels, Biomass & Waste, Wind, Solar, Marine, Geothermal, Small Hydro. Europe includes the continent (i.e. more than EU-28). Countries include top 5 in total GHG emissions from energy consumption, plus California, Brazil, and others as space allows. Data Source: Bloomberg New Energy Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

COUNTRY HIGHLIGHTS

SOUTH KOREA

#8 in GHG emissions from energy consumption

Emissions per capita =13.45, GDP per capita = $26,600
Goal: GHG emissions 30% below business as usual by 2020

South Korea's economy experienced rapid growth in recent decades and is now an industrialized nation that ranks 12th in GDP.[66] This growth impacted its GHG emissions, which more than doubled between 1990 and 2012 to make the nation the eighth largest emitter of GHGs from energy consumption. South Korea also ranks poorly in emissions per capita (#41) and carbon intensity (#28).

South Korea's pledge to the 2009 Copenhagen Accord is to reduce emissions by 30 percent from business as usual by 2020, which equates to 4 percent below 2005 levels.[67] The country is reliant on fuel imports to meet 97 percent of its energy demand and has only 2 percent of its electricity from renewable sources, which present challenges to achieving this goal.[68] South Korea outlined its plan to fight climate change in its National Strategy for Green Growth. The strategy and subsequent Enforcement Decree of the Framework Act on Low Carbon includes low-carbon growth areas such as improving energy efficiency, increasing renewable energy, and reducing emissions from transportation.[69] South Korea implemented a Renewable Portfolio Standard in 2012 to increase to 10 percent renewable electricity by 2022, and has a one million green homes program that provides a subsidy for the residential sector to install renewables.[70]

One of South Korea's primary strategies to achieve its reduction target is an emissions trading scheme, which launched in January 2015. The carbon trading system covers 525 companies, such as power generators and industrial firms, which account for about 66 percent of the country's emissions.[71]

TRANSPORTATION

WHY IS IT IMPORTANT?

The global transportation network of highways, railways, and shipping and aviation routes facilitates economic activity and improves travel convenience for residents and companies. But it also takes a vast amount of energy to fuel vehicles, and most vehicles are still reliant on petroleum. Therefore, it is important to measure progress in transitioning to alternative fuel vehicles that will reduce emissions.

TRANSPORTATION INDICATORS

The transportation sector accounts for a significant portion of global GHG emissions, and more efficient modes of transportation are required to reduce these emissions. In California alone the transportation sector accounts for more than a third of the state's GHG emissions, and close to half the state's emissions when you include upstream emissions and refineries. A variety of factors influence an individual's transportation choices, including availability of options, fuel prices (in particular relative to income levels), affordability, and government incentives or disincentives for cleaner transportation options.

As of March 2, 2015, the pump price for gasoline was highest in Hong Kong and the Netherlands at the equivalent of $7.27 and $7 per gallon, respectively. California and the U.S. had much lower prices at about $3.42 and $2.54 per gallon, respectively (Table 13). The price of oil was cut in half in 2014, leading to a drop in gas prices. If low prices continue, there may be a risk of slowing the transition to more efficient vehicles.

Brent Crude Oil Prices were cut in half in 2014, dropping from **$110/barrel** on July 4, 2014 to **$60/barrel** on February 27, 2015, leading to falling gas prices in recent months.

TABLE 13. PUMP PRICE FOR GASOLINE

MARCH 2, 2015 PRICE IN U.S. DOLLARS PER LITER AND GALLON

RANK	REGION	US$ / LITER	US$ / GALLON
1	HONG KONG	$1.92	$7.27
2	NETHERLANDS	$1.85	$7.00
3	ITALY	$1.77	$6.70
4	TURKEY	$1.71	$6.47
5	UNITED KINGDOM	$1.69	$6.40
6	GREECE	$1.67	$6.32
6	ISRAEL	$1.67	$6.32
8	UKRAINE	$1.60	$6.06
9	BELGIUM	$1.54	$5.83
9	FRANCE	$1.54	$5.83
13	EU-28	$1.45	$5.51
24	CHINA	$1.07	$4.05
25	INDIA	$1.05	$3.97
32	CALIFORNIA	$0.90	$3.42
39	U.S. (WITH CALIFORNIA)	$0.67	$2.54
41	RUSSIA	$0.57	$2.16

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal). Rank is among the top 50 regions in total GHG emissions from consumption of energy.
Data Source: Global Petrol Prices; California Energy Commission. Analysis: Collaborative Economics.
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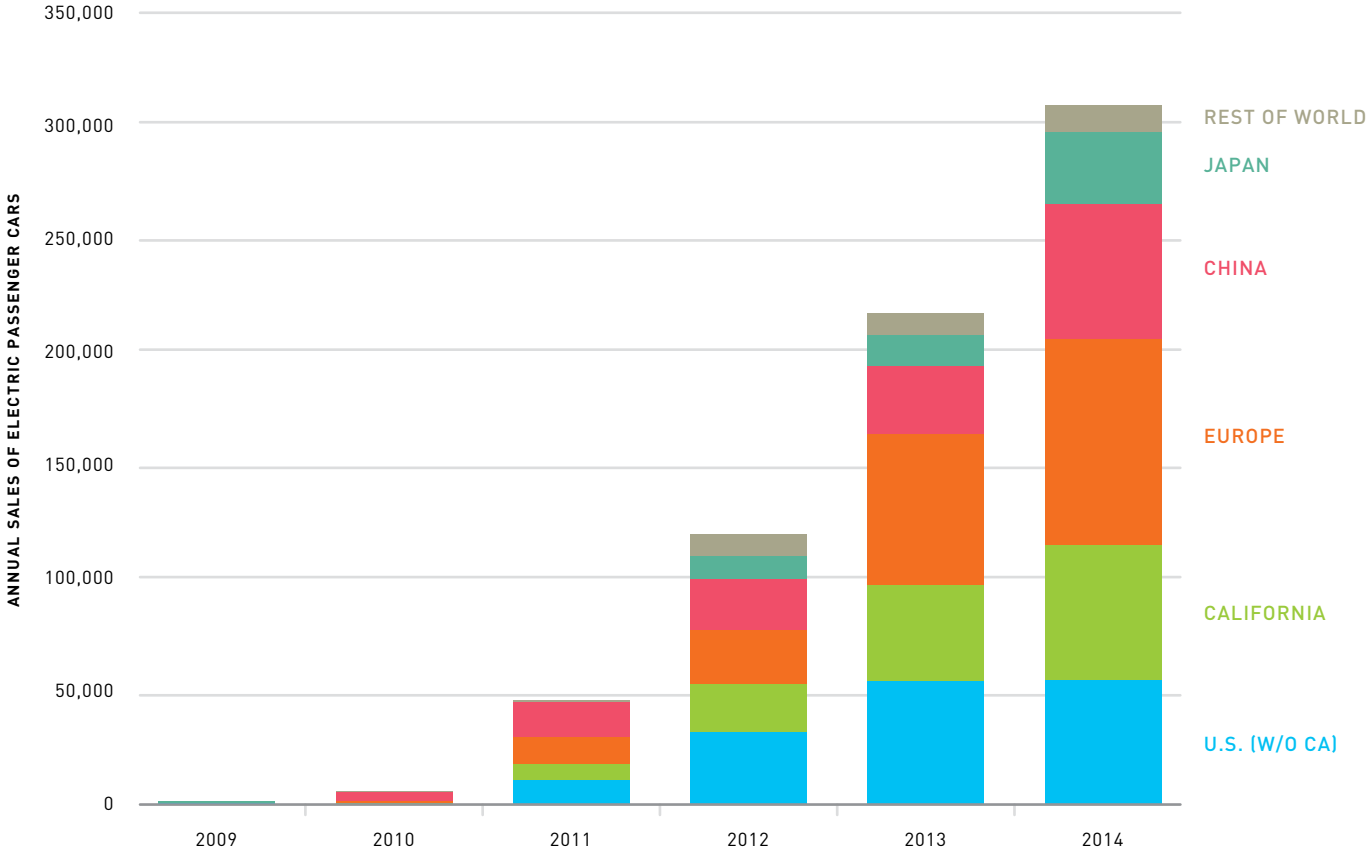
A transition to zero emission vehicles is a key strategy for reducing transportation emissions. Electric vehicles are the most widely available zero emission vehicle; they are more efficient than traditional vehicles and use electricity, which is on average lower in emissions than gasoline. The U.S. is a global leader in the transition to cleaner transportation, driven by strong state policies such as California's plans to increase zero emission vehicles, incentives for public charging infrastructure and clean vehicle rebates, and policies to reduce the need to drive including the Sustainable Communities and Climate Protection Act of 2008.

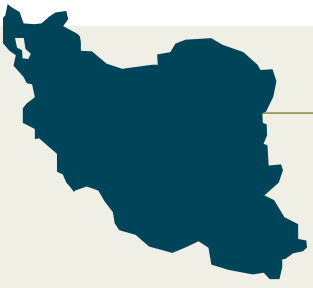
In 2014, the U.S. had the most electric vehicle sales in the world with over 110,000 vehicles, or 37 percent of the global total. Over half of the U.S.'s electric vehicles were sold in California (Figure 20). Europe as a whole was the next largest market for electric vehicles, with 30 percent of the global total, and China jumped in 2014 to account for 19 percent of the global sales.

FIGURE 20. GLOBAL SALES OF ELECTRIC VEHICLES (PASSENGER CARS)

2009–2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: Global data - Mock, P., Yang, Z. (2014). Updated ICCT Data. Driving electrification: A global comparison of fiscal policy for electric vehicles; California data - Polk. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA



COUNTRY HIGHLIGHTS

IRAN

#9 in GHG emissions from energy consumption

Emissions per capita =7.65, GDP per capita = $4,600

Pledge: No public emissions goals

Iran is ninth in the world for the most energy-related emissions and tripled emissions between 1990 and 2012. Even with this increase and being a relatively high-income country, Iran does not have a pledge to reduce emissions.[72]

Iran ranks in the middle for emissions per capita (#27) and poorly in carbon intensity (#48). Iran has some of the world's largest oil and natural gas reserves, and ranks in the top 10 oil producers and top five natural gas producers. Given these domestic resources, Iran relies on oil and natural gas for its total primary energy consumption, accounting for 98 percent of the total in 2012.[73] Iran recently acknowledged the local pollution these fossil fuels are causing, and in 2014 announced plans to set up a carbon trading market to reduce industrial emissions.[74]

CLEAN TECHNOLOGY INNOVATION

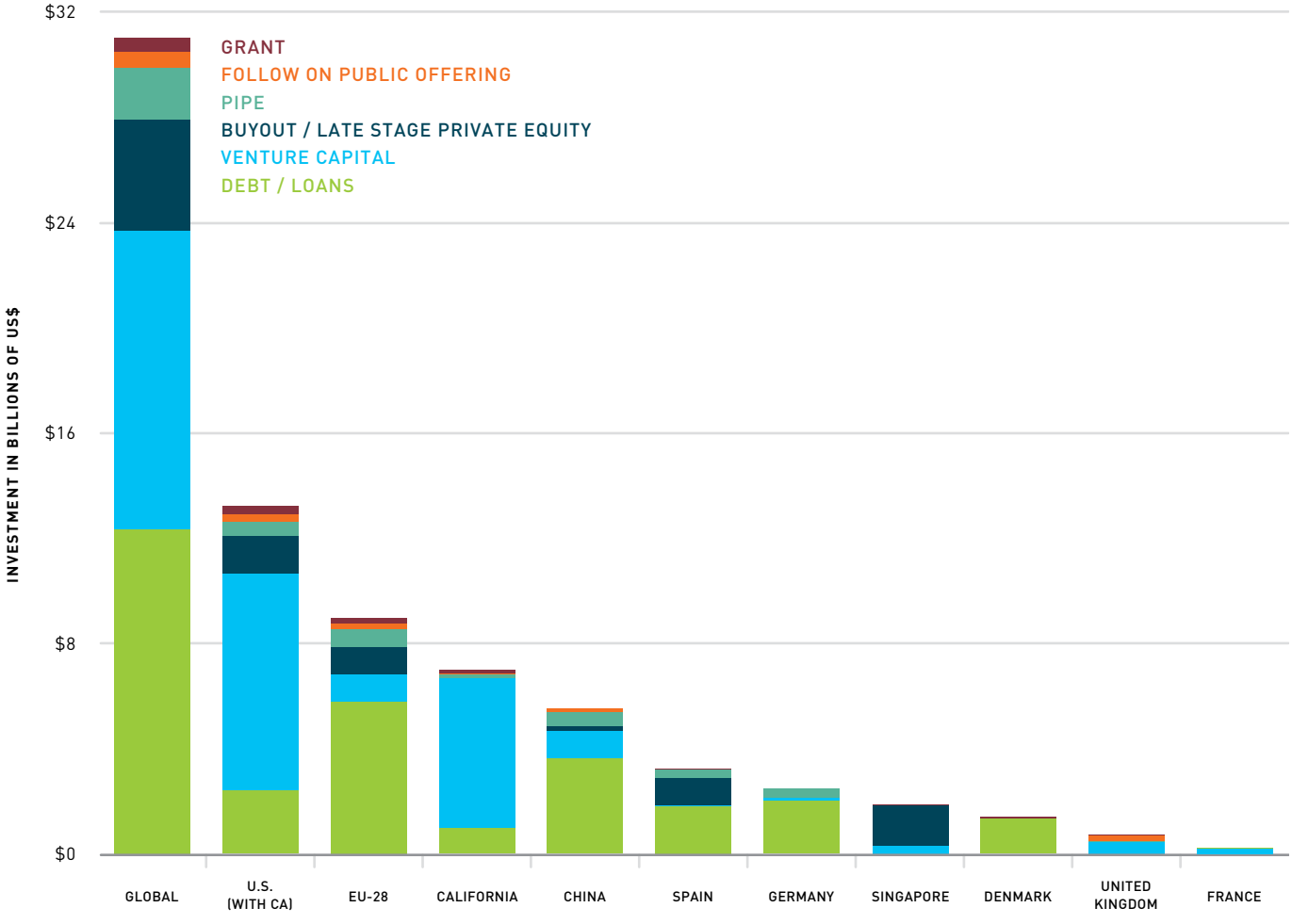
WHY IS IT IMPORTANT?

Financial investments in clean technology companies help to research, commercialize, and scale new products and services. Similarly, patent registrations are one measure of knowledge accumulated through private and public investment in research and development, and represent potential growth in the clean technology sector in the future. Looking at changes in clean technology investments and patents together can illustrate the role of California and other countries in leading the shift to a clean economy.

INVESTMENT IN CLEAN TECHNOLOGY

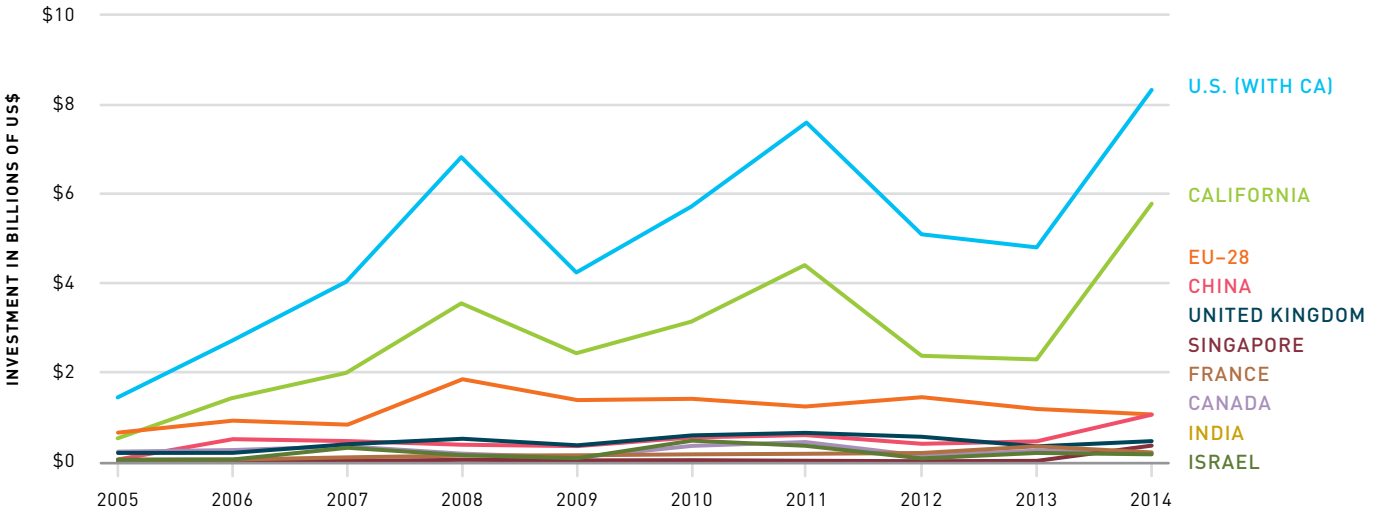
Investment fuels clean technology innovation, allowing companies and researchers to create and improve new, ground-breaking products and services. These types of investments are becoming more diversified, with new types of financing emerging as more investors gain understanding of the technologies and value proposition of clean technology. Total investment in clean technology companies reached $31 billion in 2014, up 6 percent compared to 2013 (Figure 21). This investment includes venture capital, debt/loans, grants from public and private sources, private and public equity, and follow-on public offerings. Loans from sources such as

FIGURE 21. TOTAL INVESTMENT IN CLEAN TECHNOLOGY COMPANIES
BY INVESTMENT TYPE, 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal). Regions include top 10 regions of total investment in 2014. Venture capital includes Seed, Series A, Series B, and Growth Equity; Debt/Loans includes Structured Debt, Loans, and Loan Guarantees. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 22. VENTURE CAPITAL INVESTMENT IN CLEAN TECHNOLOGY COMPANIES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal) regions include the top 10 of VC investment in 2014. The company Uber accounted for $3 billion of the California, the U.S., and the World totals in 2014. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

private banks accounted for 40 percent of the global total in 2014, followed by private venture capital with 37 percent of the total.

The U.S. had the largest share (43%) of total investment in 2014, more than half of which was invested in California. Given that EU-28 (and its member countries), the U.S., and China have the largest GDP, it follows closely that they also received the largest amount of investments for clean technology companies.

Venture capital is one of the primary avenues for startup companies to secure the capital needed to create new, innovative products and services. While other types of investors are also important to help grow and expand the cleantech market, venture capitalists play a unique role because of their tolerance for early stage, high-risk investments and management expertise. Overall venture capital investment has fluctuated in recent years, which is expected in a diverse and relatively young market, though companies are still emerging and receiving investment.

Global venture capital investment reversed its two year decline in 2014 to reach over $11 billion, a 63 percent increase compared to 2013. About half of the 2,400 venture capital firms that invest in clean technology are located in the United States. The U.S. received 72 percent of global investment in 2014, with a total of $8.2 billion (Figure 22).

TABLE 14. VENTURE CAPITAL INVESTMENT IN CLEAN TECHNOLOGY COMPANIES

TOP REGIONS IN BILLIONS OF US$

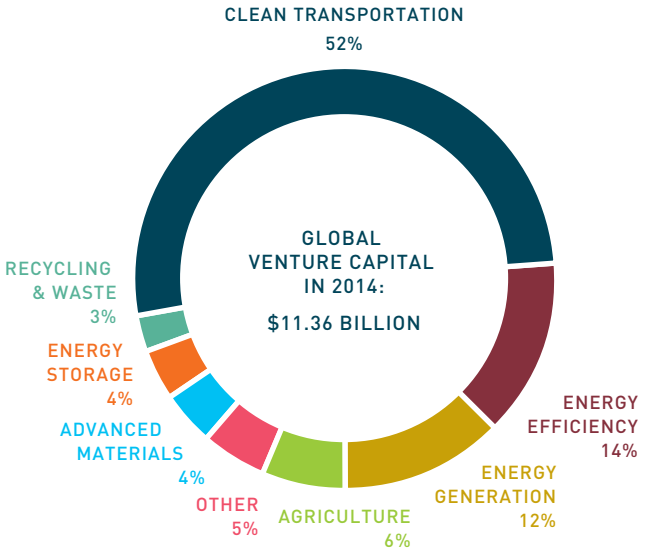
RANK	REGION	2014	2013–2014 % CHANGE
1	U.S. (WITH CALIFORNIA)	$ 8.208	74%
2	CALIFORNIA	$ 5.691	153%
3	EU-28	$ 1.028	-10%
4	CHINA	$ 1.022	135%
5	UNITED KINGDOM	$ 0.436	34%
6	SINGAPORE	$ 0.334	5677%
7	FRANCE	$ 0.187	-43%
8	CANADA	$ 0.185	-19%
9	INDIA	$ 0.167	-4%
10	ISRAEL	$ 0.167	-11%
	WORLD TOTAL	$ 11.361	63%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal), the company Uber accounted for $3 billion of the California, the U.S., and the World totals in 2014. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

California consistently accounts for the majority of the U.S. investment, and reached $5.7 billion in 2014. More than half of California's 2014 total came from one company ($3 billion for the car sharing company Uber), though after removing that company the total venture capital investment in 2014 still increased 20 percent compared to 2013. The EU-28 received

FIGURE 23. GLOBAL VENTURE CAPITAL INVESTMENT IN CLEAN TECHNOLOGY COMPANIES

BY SEGMENT, 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Other includes Water & Wastewater, Smart Grid, Air & Environment, and Green Buildings. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

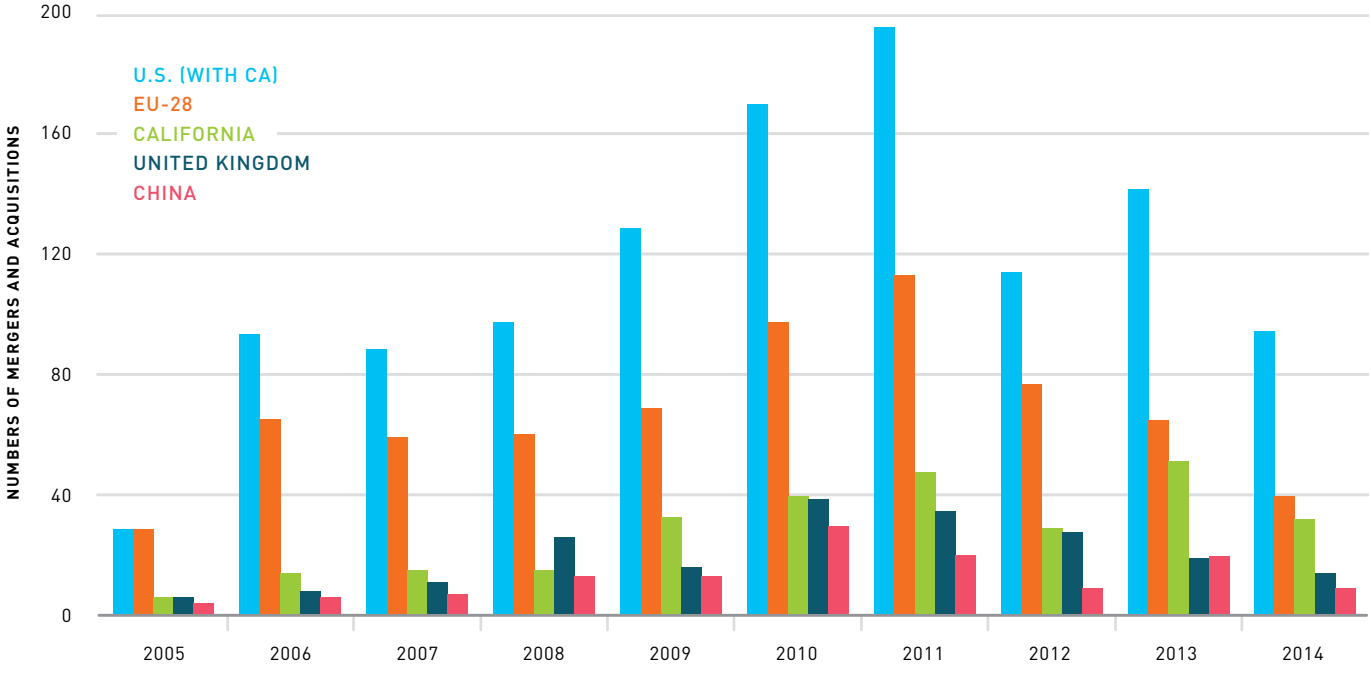
the third largest venture capital investment in 2014 with $1.03 billion, followed closely by China with $1.02 billion (Table 14).

Global clean technology venture capital investment is spread across a variety of areas. Clean transportation received the majority of investment in 2014, with $5.9 billion or 52 percent of the total (Figure 23). Even without the large investment in Uber, clean transportation was still the largest segment in 2014. Clean transportation includes companies developing technologies such as advanced biofuels, electric vehicles, logistics efficiency software, and car sharing. Energy efficiency was the next largest segment with $1.6 billion in 2014 for technologies such as efficient windows, lighting, and energy management software. Energy generation was the third largest segment with $1.4 billion for renewable energy technologies such as solar.

Clean technology company exits from the private market are an important indicator to track the growth of the sector, and can help a company develop and return value to investors. These exits can include mergers and acquisitions (M&A) (of the whole company, unit, or workers only) or an Initial Public Offering (IPO) to become a publicly traded company.

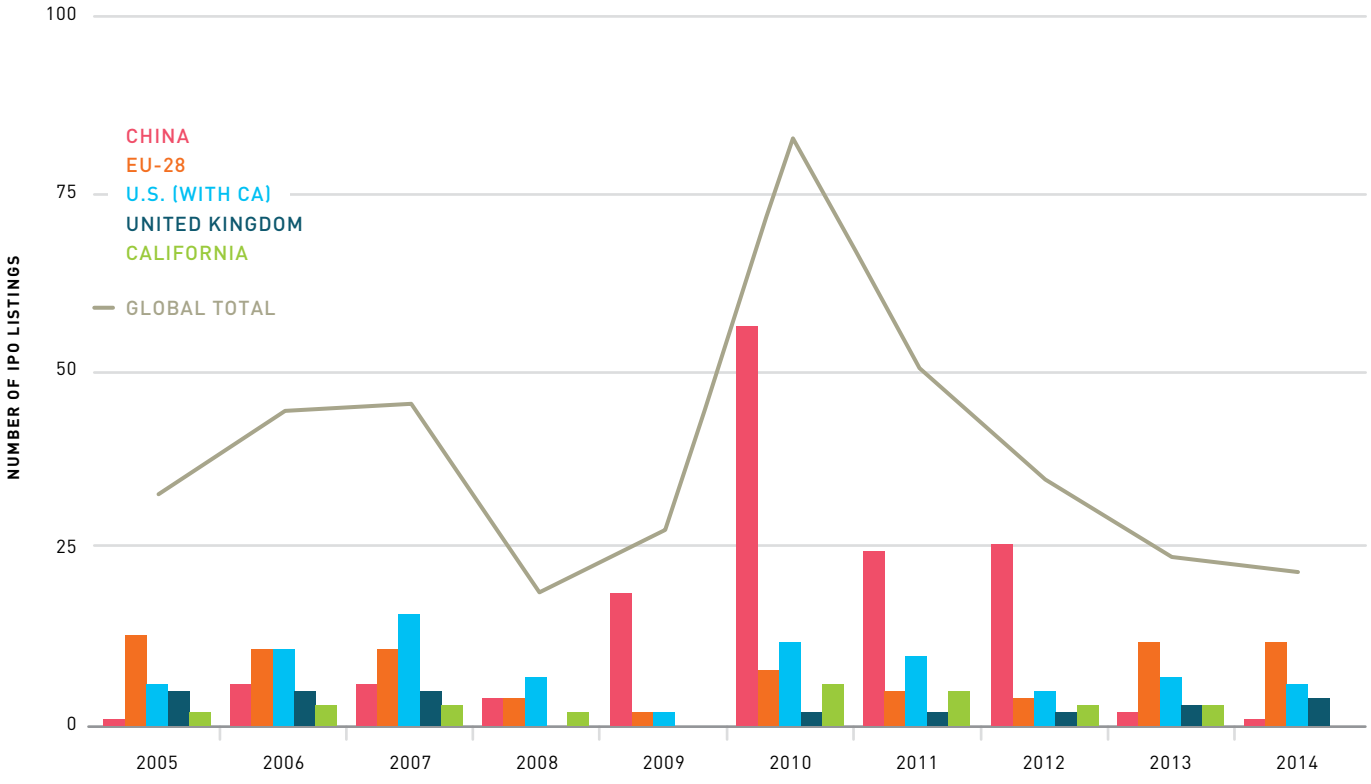
FIGURE 24. MERGERS AND ACQUISITIONS OF CLEAN TECHNOLOGY COMPANIES

BY REGION OF TARGETED COMPANY

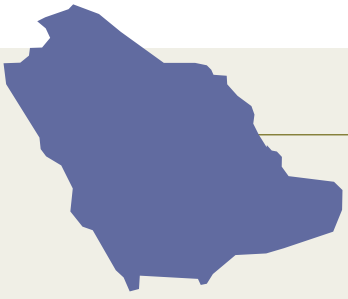


NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Includes number of M&As based on country of targeted company for top 5 regions (calculated as total M&A in 2014). Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 25. INITIAL PUBLIC OFFERINGS (IPO) OF CLEAN TECHNOLOGY COMPANIES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Includes numbers of IPOs listed by year for top 5 regions (calculated as the top for IPO listings in 2005–2014 total). Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA



COUNTRY HIGHLIGHTS

SAUDI ARABIA

#10 in GHG emissions from energy consumption

Emissions per capita = 21.96, GDP per capita = $27,400
Pledge: No public emissions goals

Saudi Arabia is tenth in the world for largest energy-related emissions. It nearly tripled emissions between 1990 and 2012, and emissions increased 24 percent between 2010 and 2012 alone. Despite this rapid increase and being a relatively high-income country, Saudi Arabia does not have a pledge to reduce emissions.[75]

Saudi Arabia ranks near the bottom in both emissions per capita (#46) and carbon intensity (#41). Home to the world's largest known oil reserves, it is the largest exporter of total petroleum liquids. The national economy is heavily dependent on oil, with 85 percent of its export revenue from petroleum in 2013. Saudi Arabia also relies on these domestic resources for local energy, and oil and natural gas account for nearly all of its total primary energy consumption. In order to meet its growing local demand for energy and to free up more oil for exports, the King Abdullah City for Atomic and Renewable Energy program recently set a vision for half of its electricity from renewable sources by 2032.[76]

In recent years, most of the global M&As occurred at clean technology companies located in the U.S., EU-28, California, United Kingdom, and China (Figure 24). Global M&As surged in 2010 and 2011 following the surge in the market at that time, and decreased in recent years to reach a total of 161 in 2014. The U.S. accounted for more than half of all M&As in recent years, while EU-28 and California took second and third spots, respectively.

The five top regions for clean technology company M&As were the same for IPOs, though with a different order. Global IPOs peaked in 2010 with a surge of new entries from China, though China dropped to two IPOs in 2013 and only one in 2014 (Figure 25). The EU-28 took the top spot for IPOs in 2013 and 2014, with 12 each year, followed by the U.S. with six and the United Kingdom with four in 2014. California had three IPOs in 2012 and 2013, though it did not have any in 2014.

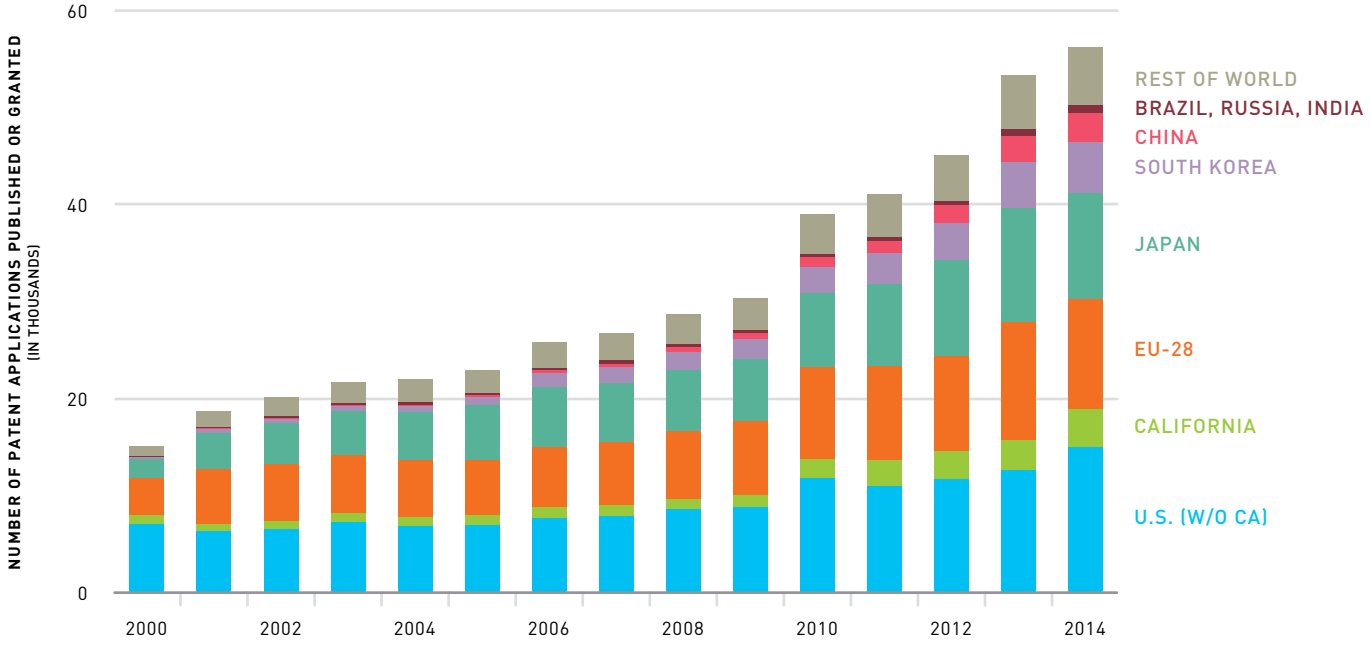
CLEAN TECHNOLOGY PATENTS

Clean technology intellectual property grew rapidly over the past fifteen years, reflecting strong research and development and commercialization efforts around the world. Between 2000 and 2014, the annual number of clean technology patent documents, including published patent applications and granted patents, more than tripled worldwide, bringing the cumulative number of clean technology patents throughout that period to about 466,700 (Figure 26).[31]

The top ranking regions in patents are also among those with the largest economies (in terms of GDP), and therefore have relatively more resources for innovation activities than lower income countries. Inventors based in the U.S. (including California) had the highest number of patents in 2014 with nearly 19,000 patents (outranking the EU-28 which had the largest GDP), and more than doubled the number of patents annually since 2000. California accounted for 21 percent of total U.S. clean technology patents in 2014, with 3,900 patent documents, more than China during the same period. China's annual clean technology patents increased the most among the top inventor regions, rising from roughly 40 patents in 2000 to 2,950 in 2014. South Korea grew at the second fastest rate with a thirty-fold expansion, surging from 175 patents in 2000 to about 5,300 in 2014.

FIGURE 26. GLOBAL CLEAN TECHNOLOGY PATENTS

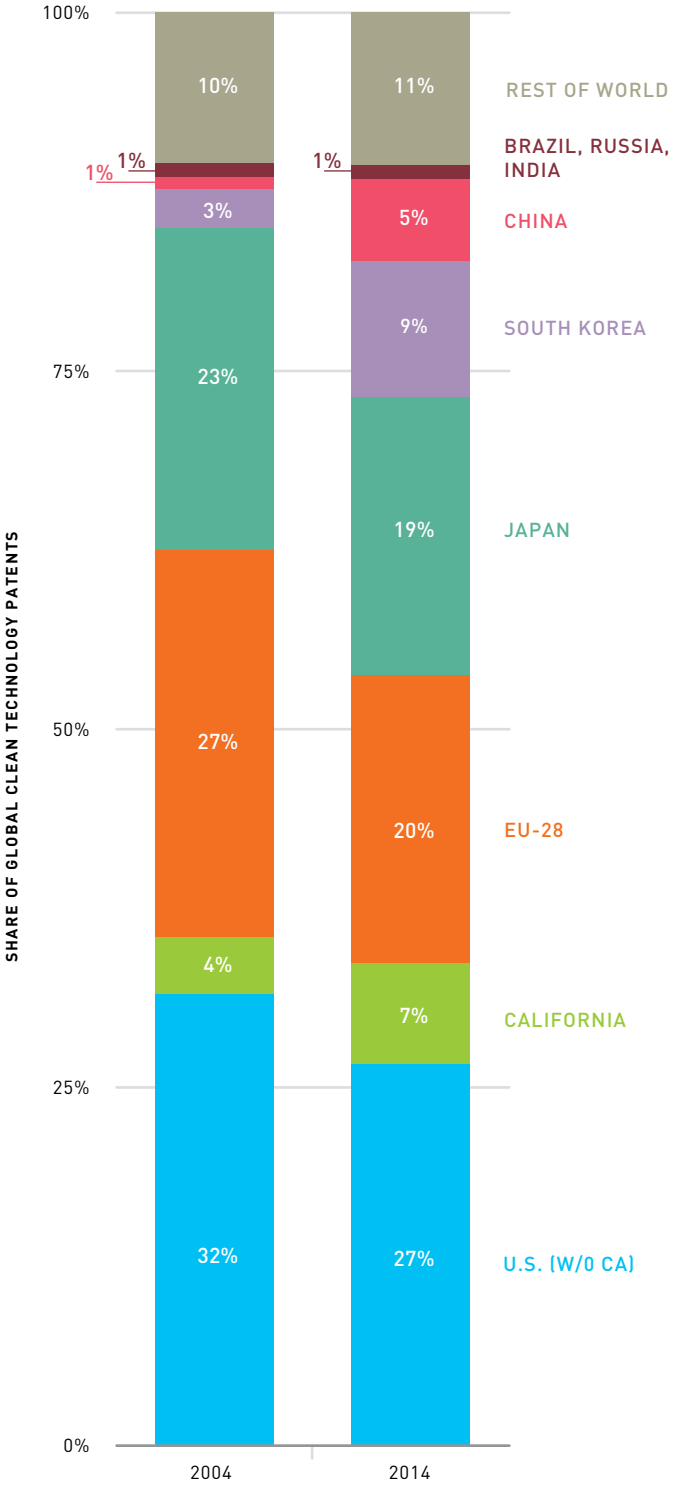
BY RESIDENCE OF FIRST INVENTOR, 2000–2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Number of patents is measured by first patent application published or granted in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 27. GLOBAL CLEAN TECHNOLOGY PATENT REGISTRATIONS

BY RESIDENCE OF FIRST INVESTOR



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Number of patents measured by first patent application published or granted in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 15. TOTAL CLEAN TECHNOLOGY PATENT RANKING

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	U.S. (WITH CALIFORNIA)	18,937
2	EU-28	11,330
3	JAPAN	10,903
4	SOUTH KOREA	5,314
5	GERMANY	4,496
6	CALIFORNIA	3,903
7	CHINA	2,954
8	TAIWAN	2,360
9	FRANCE	1,532
10	UNITED KINGDOM	1,200

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of all countries, by residence of first inventor. Number of patents measured by first patent in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

The EU-28 and Japan ranked second and third in terms of total clean technology patents in 2014 (11,330 and 10,900 respectively). The EU-28 nearly tripled its patenting rate between 2000 and 2014, and Japan's annual patent documents expanded five-fold over the same period. Clean technology patents from inventors in Brazil, Russia, and India collectively reached a total of 800 in 2014, half of which came from India.

The global distribution of clean technology patenting activity shifted slightly over the years (Figure 27). Inventors from the U.S., EU-28, and Japan collectively accounted for roughly three-quarters of all global clean technology patents in 2014, though this share declined from 85 percent in 2000. China and South Korea both increased their patenting market share, rising to 5 percent and 9 percent, respectively, in 2014. The share of patents to California-based inventors rose from 4 percent in 2000 to 7 percent in 2014. Taiwan and Canada lead the share expansion in the "Rest of World" category.

Growth in South Korea and China also impacted the regional rankings of total clean technology patents, though the U.S., EU-28, and Japan remained at the top (Table 15). Among the EU-28 countries, inventors from Germany, France, and the United Kingdom had the most patent documents in 2014, ranking fifth, ninth, and 10th in the world. South Korea surpassed Germany in 2014 for the first time to reach fourth, while California held steady at the sixth place since 2011. China

also ascended markedly over the past fifteen years, rising to seventh place in 2014 from 18th in 2000.

Countries vary in the technology focus and specialization of their patenting activities (Figure 28). U.S. inventors, for example, had the highest number of patents of any country in renewable energy technologies, and also had a high share (20%) of its patenting activity in green materials in 2014. In the EU-28, renewable energy technology and clean transportation accounted for the highest shares of total patents (24% and 18%, respectively). Japan specialized in energy storage technologies in 2014, accounting for 25 percent of its total and the highest number worldwide in this area. China and South Korea focused in energy efficiency technologies, which accounted for 30 percent and 27 percent of their clean technology patents in 2014, respectively. California-based inventors had the most activity in renewable energy, led by solar patents, and energy efficiency.

Energy Efficiency

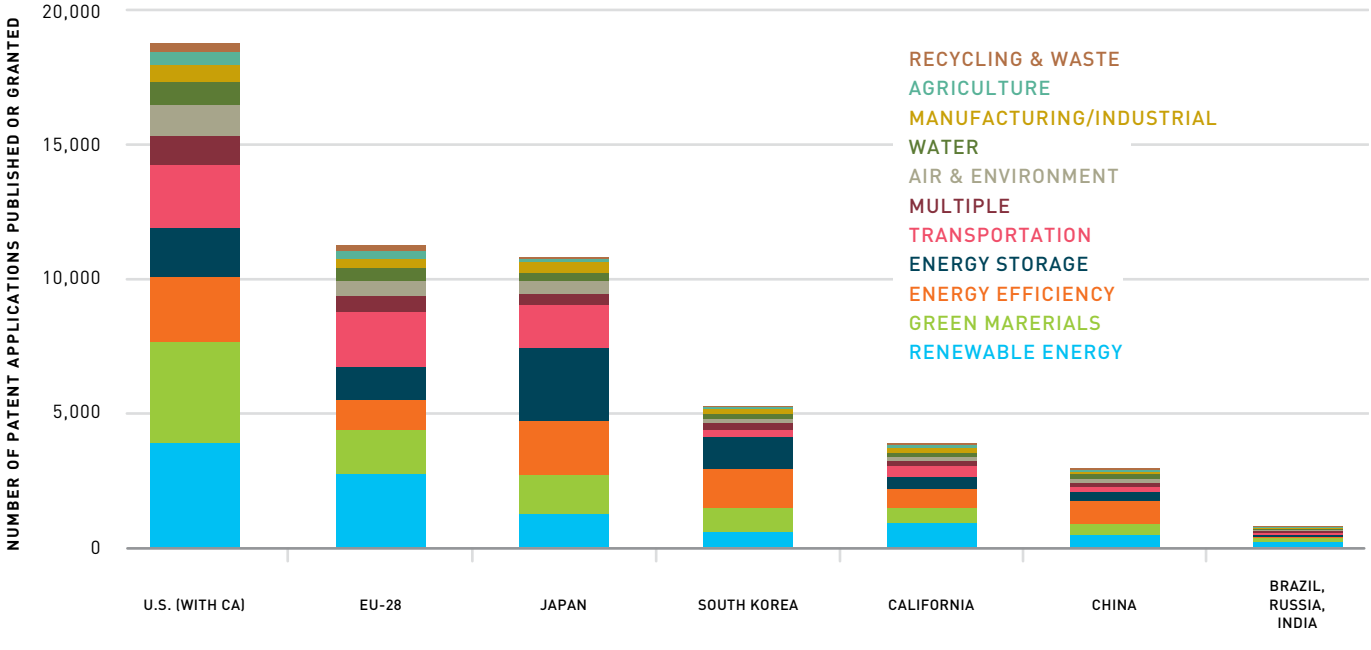
In 2014, the U.S. led energy efficiency technology patents, followed by Japan and South Korea (Table 16). The U.S. and Japan have vied for first position in this segment, alternating rankings periodically over the past decade. While all of these countries increased their patenting in the energy efficiency segment in recent years, some regions expanded particularly quickly, shifting the rankings. Energy efficiency is South Korean inventors' largest patenting segment, and the country has held steady in third place since 2010 when it surpassed the EU-28. Taiwan, China, and California also ascended in the energy efficiency patent rankings in recent years.

Energy Storage

Japan had the most patents in energy storage technologies since 2003, drawing on its strong history in research and development of electronic and automotive batteries (Table 17). Some of the most active energy storage patenting companies in Japan include Toyota, Panasonic, Samsung, and Honda. The U.S. and EU-28 maintained second and third positions in energy storage, and California has held steady in sixth place since 2010.

FIGURE 28. CLEAN TECHNOLOGY PATENTS BY TECHNOLOGY TYPE

BY RESIDENCE OF FIRST INVENTOR, 2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Number of patents is measured by first patent in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

Solar Energy

The U.S. led in solar energy patenting by a wide margin in 2014, 87 percent above the next highest region, the EU-28 (Table 18). California plays a key role in the U.S. patenting leadership in solar and accounted for 34 percent of all U.S. solar patents in 2014. South Korea, Germany, and California alternated across the fourth to sixth ranking positions in recent years, with California surpassing both South Korea and Germany for the first time in 2014.

Wind Energy

The EU-28 was the world leader in wind energy technology patents in 2014 driven by robust activity in Germany and Denmark, which accounted for 39 percent and 22 percent of the region's patents, respectively (Table 19). Though the EU-28 led the U.S. by a 45 percent margin in 2014, U.S.-based inventors have been gaining ground in recent years. California's wind energy patents quadrupled over the last decade, though this remains one of the state's smaller clean technology patent segments.

Clean Transportation

The U.S, EU-28, and Japan were leaders in clean transportation patents in 2014, with Germany, France, and the United Kingdom driving EU-28 leadership in this segment (Table 20). Globally, the top patenting companies in the clean transportation segment in 2014 were Toyota, Robert Bosch GMBH, Honda Motors Corporation, and Yamaha. California's clean transportation patents more than doubled between 2000 and 2014, and the state ranked fifth in 2014, above France, South Korea, and many other countries.

Air & Environment

The U.S. had more patents in air & environment technologies than those of the EU-28 and Japan (#2 and #3, respectively) combined (Table 21). Air & environment technologies include those for emissions control, hazardous cleanup, monitoring/compliance, and trading & offsets. California accounted for 14 percent of U.S. patent activity in this segment.

TABLE 16. ENERGY EFFICIENCY PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	U.S. (WITH CALIFORNIA)	2,663
2	JAPAN	2,162
3	SOUTH KOREA	1,512
4	EU-28	1,211
5	TAIWAN	930
6	CHINA	914
7	CALIFORNIA	729
8	GERMANY	393
9	NETHERLANDS	219
10	CANADA	150

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.

NEXT 10 / SF · CA · USA

TABLE 17. ENERGY STORAGE PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	JAPAN	2,987
2	U.S. (WITH CALIFORNIA)	2,303
3	EU-28	1,505
4	SOUTH KOREA	1,383
5	GERMANY	770
6	CALIFORNIA	571
7	CHINA	412
8	TAIWAN	292
9	FRANCE	265
10	UNITED KINGDOM	148

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.

NEXT 10 / SF · CA · USA

TABLE 18. SOLAR ENERGY PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	U.S. (WITH CALIFORNIA)	1,464
2	EU-28	782
3	JAPAN	683
4	CALIFORNIA	497
5	SOUTH KOREA	348
6	GERMANY	312
7	CHINA	241
8	TAIWAN	207
9	FRANCE	122
10	ITALY	78

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family.
Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

TABLE 19. WIND ENERGY PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	EU-28	835
2	U.S. (WITH CALIFORNIA)	577
3	GERMANY	323
4	JAPAN	127
5	CALIFORNIA	101
6	CHINA	81
7	SPAIN	80
8	UNITED KINGDOM	78
9	SOUTH KOREA	40
10	TAIWAN	35

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family.
Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

TABLE 20. CLEAN TRANSPORTATION PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	U.S. (WITH CALIFORNIA)	2,719
2	EU-28	2,295
3	JAPAN	1,767
4	GERMANY	928
5	CALIFORNIA	499
6	FRANCE	428
7	SOUTH KOREA	317
8	UNITED KINGDOM	233
9	CHINA	232
10	TAIWAN	204

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family.
Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

TABLE 21. AIR AND ENVIRONMENT PATENT RANKINGS

TOP RANKING REGIONS IN 2014

RANK	REGION	NUMBER OF PATENTS
1	U.S. (WITH CALIFORNIA)	1,413
2	EU-28	680
3	JAPAN	572
4	GERMANY	300
5	CALIFORNIA	193
6	CHINA	180
7	SOUTH KOREA	160
8	UNITED KINGDOM	85
9	CANADA	77
10	FRANCE	75

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Rank is out of top 50 GHG polluters, by residence of first inventor. Number of patents measured by first patent in patent family.
Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics.
NEXT 10 / SF · CA · USA

BRIEF SUMMARY OF GHG REDUCTION PLEDGES FROM OTHER LARGE EMITTERS

CANADA

#11 in GHG emissions from energy consumption

Emissions per capita = 16.06, GDP per capita = $52,400

Pledge to reduce GHG emissions 17% below 2005 levels by 2020; under current policies expected to miss this goal by a wide margin.

BRAZIL

#12 in GHG emissions from energy consumption

Emissions per capita = 2.51, GDP per capita = $11,100

Pledge to reduce 36.1% to 38.9% below business-as-usual emissions by 2020; currently on track to meet target.

UNITED KINGDOM

#13 in GHG emissions from energy consumption

Emissions per capita = 7.91, GDP per capita = $42,000

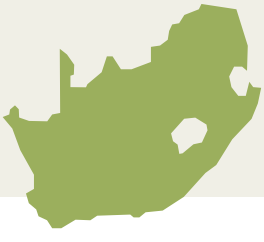
Part of EU-28 pledge of emissions 20% below 1990 levels by 2020; also national policy with goal of 80% below 1990 levels by 2050, expected to fall short of interim targets.

SOUTH AFRICA

#14 in GHG emissions from energy consumption

Emissions per capita = 9.69, GDP per capita = $7,200

Pledge to reduce 34% below business-as-usual emissions by 2020; current policies not on track to meet 2020 goal, though could reduce by 2030.



INDONESIA

#15 in GHG emissions from energy consumption

Emissions per capita = 1.83, GDP per capita = $3,400

Pledge to reduce 26% below business-as-usual emissions by 2020; reductions expected by 2020 but not to the goal level, though uncertain depending on land use sector.

MEXICO

#16 in GHG emissions from energy consumption

Emissions per capita = 3.87, GDP per capita = $10,500

Pledge to reduce 30% below business-as-usual emissions by 2020; currently expected to reduce but not meet 2020 goal; one of the first to set 2030 goal of 22% reduction in emissions and 51% in Black Carbon compared to business-as-usual.

AUSTRALIA

#17 in GHG emissions from energy consumption

Emissions per capita = 19.11, GDP per capita = $69,300

Pledge to reduce 5% below 2000 base level emissions by 2020; with repeals of policies in 2014 not on track to meet goal.

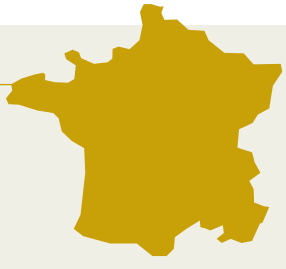
ITALY

#18 in GHG emissions from energy consumption

Emissions per capita = 6.30, GDP per capita = $34,800

Part of EU-28 pledge of emissions 20% below 1990 levels by 2020.

FRANCE



#19 in GHG emissions from energy consumption

Emissions per capita = 5.55, GDP per capita = $42,400

Part of EU-28 pledge of emissions 20% below 1990 levels by 2020.

CALIFORNIA

#20 in GHG emissions from energy consumption

Emissions per capita = 9.16, GDP per capita = $58,000

Policy to reduce emissions to 1990 levels by 2020; expected to meet goal through strategies in its Scoping Plan. Executive Orders to reduce GHG emissions 40 percent below 1990 levels by 2030 and 80 percent below 1990 levels by 2050.

INTERNATIONAL
INDEX SUMMARY

INTERNATIONAL INDEX SUMMARY

RANKING SUMMARY OF THE TOP 50 POLLUTERS OF GHG EMISSIONS FROM ENERGY CONSUMPTION

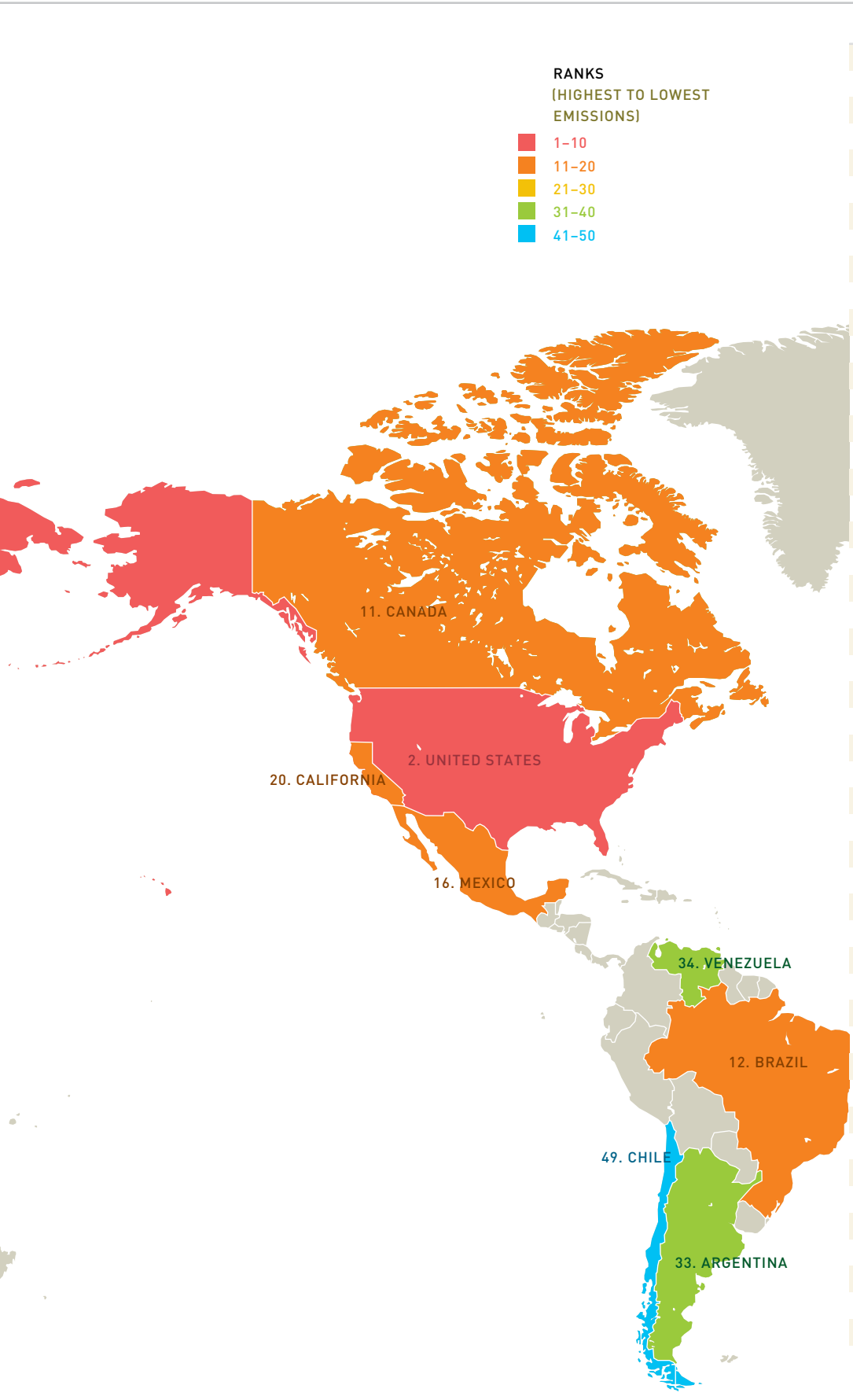
RANK	TOTAL GHG EMISSIONS FROM ENERGY CONSUMPTION RANKING	CARBON ECONOMY RANKING		GHG EMISSIONS PER CAPITA RANKING	ENERGY PRODUCTIVITY RANKING
	TOTAL EMISSIONS	CARBON INTENSITY ($MTCO_2e$/GDP) IN 2012	2013 GDP PER CAPITA, US$	EMISSIONS PER CAPITA ($MTCO_2e$/GDP) IN 2012	ENERGY PRODUCTIVITY (GDP/BTU) IN 2012
1	CHINA	FRANCE*	$42,355	NIGERIA	NIGERIA
2	U.S. (WITH CALIFORNIA)*	CALIFORNIA	$58,016	PAKISTAN	ITALY*
3	EU-28*	ITALY*	$34,849	PHILIPPINES	JAPAN*
4	INDIA	NIGERIA	$2,945	VIETNAM	UNITED KINGDOM*
5	RUSSIA	UNITED KINGDOM*	$42,020	INDIA	CALIFORNIA
6	JAPAN*	BRAZIL	$11,081	INDONESIA	GERMANY*
7	GERMANY*	JAPAN*	$38,705	EGYPT	FRANCE*
8	SOUTH KOREA*	SPAIN*	$29,181	BRAZIL	ISRAEL*
9	IRAN	GERMANY*	$46,054	ALGERIA	EU-28*
10	SAUDI ARABIA	EU-28*	$35,110	TURKEY*	SPAIN*
11	CANADA*	BELGIUM*	$50,224	MEXICO*	GREECE*
12	BRAZIL	NETHERLANDS*	$50,573	ROMANIA	AUSTRALIA*
13	UNITED KINGDOM*	ISRAEL*	$37,146	IRAQ	HONG KONG
14	SOUTH AFRICA	CANADA*	$52,441	THAILAND	NETHERLANDS*
15	INDONESIA	CHILE*	$15,964	UZBEKISTAN	BELGIUM*
16	MEXICO*	U.S. (WITH CALIFORNIA)*	$52,616	ARGENTINA	BRAZIL
17	AUSTRALIA*	GREECE*	$22,480	CHILE*	CHILE*
18	ITALY*	AUSTRALIA*	$69,326	FRANCE*	PHILIPPINES
19	FRANCE*	HONG KONG	$38,525	ITALY*	U.S. (WITH CALIFORNIA)*
20	CALIFORNIA	TURKEY*	$10,073	CHINA	TURKEY*
21	SPAIN*	PHILIPPINES	$2,527	UKRAINE	MEXICO*
22	TAIWAN	ARGENTINA	$14,175	VENEZUELA	ARGENTINA
23	TURKEY*	MEXICO*	$10,483	SPAIN*	VENEZUELA
24	THAILAND	VENEZUELA	$15,182	MALAYSIA	POLAND*
25	UKRAINE	CZECH REPUBLIC*	$19,647	EU-28*	CZECH REPUBLIC*
26	POLAND*	ROMANIA	$8,727	POLAND*	CANADA*
27	NETHERLANDS*	QATAR	$93,700	IRAN	INDONESIA
28	UNITED ARAB EMIRATES	SOUTH KOREA*	$26,602	UNITED KINGDOM*	ROMANIA
29	KAZAKHSTAN	INDONESIA	$3,424	GREECE*	IRAQ
30	SINGAPORE	POLAND*	$13,714	CZECH REPUBLIC*	QATAR
31	EGYPT	TAIWAN	$20,291	CALIFORNIA	SOUTH KOREA*
32	MALAYSIA	MALAYSIA	$10,413	SOUTH AFRICA	TAIWAN
33	ARGENTINA	UNITED ARAB EMIRATES	$71,479	GERMANY*	MALAYSIA
34	VENEZUELA	IRAQ	$7,038	JAPAN*	KUWAIT
35	PAKISTAN	PAKISTAN	$1,184	ISRAEL*	SINGAPORE
36	BELGIUM*	ALGERIA	$5,415	RUSSIA	UNITED ARAB EMIRATES
37	ALGERIA	KUWAIT	$64,108	HONG KONG	INDIA
38	VIETNAM	SINGAPORE	$53,516	KAZAKHSTAN	ALGERIA
39	IRAQ	THAILAND	$5,717	TAIWAN	PAKISTAN
40	UZBEKISTAN	EGYPT	$3,130	BELGIUM*	SOUTH AFRICA
41	KUWAIT	SAUDI ARABIA	$27,370	SOUTH KOREA*	THAILAND
42	QATAR	INDIA	$1,518	NETHERLANDS*	SAUDI ARABIA
43	CZECH REPUBLIC*	VIETNAM	$1,835	CANADA*	EGYPT
44	HONG KONG	RUSSIA	$14,717	U.S. (WITH CALIFORNIA)*	CHINA
45	GREECE*	SOUTH AFRICA	$7,248	AUSTRALIA*	KAZAKHSTAN
46	NIGERIA	CHINA	$6,816	SAUDI ARABIA	VIETNAM
47	ROMANIA	KAZAKHSTAN	$12,919	SINGAPORE	RUSSIA
48	PHILIPPINES	IRAN	$4,563	KUWAIT	IRAN
49	CHILE*	UKRAINE	$4,006	UNITED ARAB EMIRATES	UKRAINE
50	ISRAEL*	UZBEKISTAN	$1,963	QATAR	UZBEKISTAN

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. *OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.

AS ILLUSTRATED IN MAPS ON PAGES 54–69

RANK	ENERGY PER CAPITA RANKING TOTAL ENERGY CONSUMPTION PER CAPITA (BTU/PERSON) IN 2012	ELECTRICITY PER CAPITA RANKING ELECTRICITY CONSUMPTION PER CAPITA (kWh/PERSON) IN 2012	TOTAL RENEWABLE ELECTRICITY GENERATION RANKING TOTAL RENEWABLE ELECTRICITY IN 2012	SHARE OF ELECTRICITY FROM RENEWABLE SOURCES RANKING SHARE OF RENEWABLES (RENEWABLE ELECTRICITY/TOTAL ELECTRICITY) IN 2012
1	NIGERIA	NIGERIA	EU-28*	SPAIN*
2	PHILIPPINES	PAKISTAN	U.S. (WITH CALIFORNIA)*	GERMANY*
3	PAKISTAN	PHILIPPINES	CHINA	ITALY*
4	INDIA	INDONESIA	GERMANY*	CALIFORNIA
5	VIETNAM	INDIA	SPAIN*	PHILIPPINES
6	INDONESIA	ALGERIA	ITALY*	EU-28*
7	EGYPT	VIETNAM	JAPAN*	BELGIUM*
8	IRAQ	IRAQ	CALIFORNIA	NETHERLANDS*
9	ALGERIA	UZBEKISTAN	BRAZIL	UNITED KINGDOM*
10	BRAZIL	EGYPT	INDIA	GREECE*
11	TURKEY*	MEXICO*	UNITED KINGDOM*	POLAND*
12	MEXICO*	ROMANIA	FRANCE*	CHILE*
13	ROMANIA	THAILAND	CANADA*	BRAZIL
14	THAILAND	BRAZIL	POLAND*	CZECH REPUBLIC*
15	UZBEKISTAN	TURKEY*	MEXICO*	U.S. (WITH CALIFORNIA)*
16	CHINA	IRAN	NETHERLANDS*	INDONESIA
17	CHILE*	ARGENTINA	PHILIPPINES	ROMANIA
18	ARGENTINA	CHINA	BELGIUM*	JAPAN*
19	POLAND*	VENEZUELA	AUSTRALIA*	FRANCE*
20	MALAYSIA	UKRAINE	INDONESIA	MEXICO*
21	UKRAINE	POLAND*	TURKEY*	AUSTRALIA*
22	GREECE*	CHILE*	CZECH REPUBLIC*	INDIA
23	SOUTH AFRICA	MALAYSIA	GREECE*	CANADA*
24	ITALY*	SOUTH AFRICA	CHILE*	TURKEY*
25	VENEZUELA	KAZAKHSTAN	TAIWAN	THAILAND
26	IRAN	ITALY*	THAILAND	CHINA
27	SPAIN*	UNITED KINGDOM*	RUSSIA	TAIWAN
28	UNITED KINGDOM*	SPAIN*	SOUTH KOREA*	ARGENTINA
29	ISRAEL*	GREECE*	ROMANIA	SINGAPORE
30	EU-28*	EU-28*	ARGENTINA	EGYPT
31	CZECH REPUBLIC*	CZECH REPUBLIC*	EGYPT	ISRAEL*
32	KAZAKHSTAN	HONG KONG	MALAYSIA	MALAYSIA
33	JAPAN*	RUSSIA	UKRAINE	SOUTH KOREA*
34	FRANCE*	NETHERLANDS*	SINGAPORE	UKRAINE
35	GERMANY*	GERMANY*	SOUTH AFRICA	RUSSIA
36	HONG KONG	FRANCE*	ISRAEL*	HONG KONG
37	CALIFORNIA	CALIFORNIA	IRAN	SOUTH AFRICA
38	TAIWAN	ISRAEL*	VIETNAM	VIETNAM
39	RUSSIA	JAPAN*	HONG KONG	IRAN
40	SOUTH KOREA*	BELGIUM*	UNITED ARAB EMIRATES	PAKISTAN
41	NETHERLANDS*	SINGAPORE	PAKISTAN	UNITED ARAB EMIRATES
42	BELGIUM*	SAUDI ARABIA	KAZAKHSTAN	KAZAKHSTAN
43	AUSTRALIA*	TAIWAN	SAUDI ARABIA	SAUDI ARABIA
44	U.S. (WITH CALIFORNIA)*	SOUTH KOREA*	VENEZUELA	VENEZUELA
45	SAUDI ARABIA	AUSTRALIA*	ALGERIA	ALGERIA
46	CANADA*	U.S. (WITH CALIFORNIA)*	IRAQ	IRAQ
47	SINGAPORE	QATAR	UZBEKISTAN	UZBEKISTAN
48	KUWAIT	CANADA*	KUWAIT	KUWAIT
49	UNITED ARAB EMIRATES	UNITED ARAB EMIRATES	QATAR	QATAR
50	QATAR	KUWAIT	NIGERIA	NIGERIA

TOTAL GHG EMISSIONS FROM ENERGY CONSUMPTION RANKING, 2012

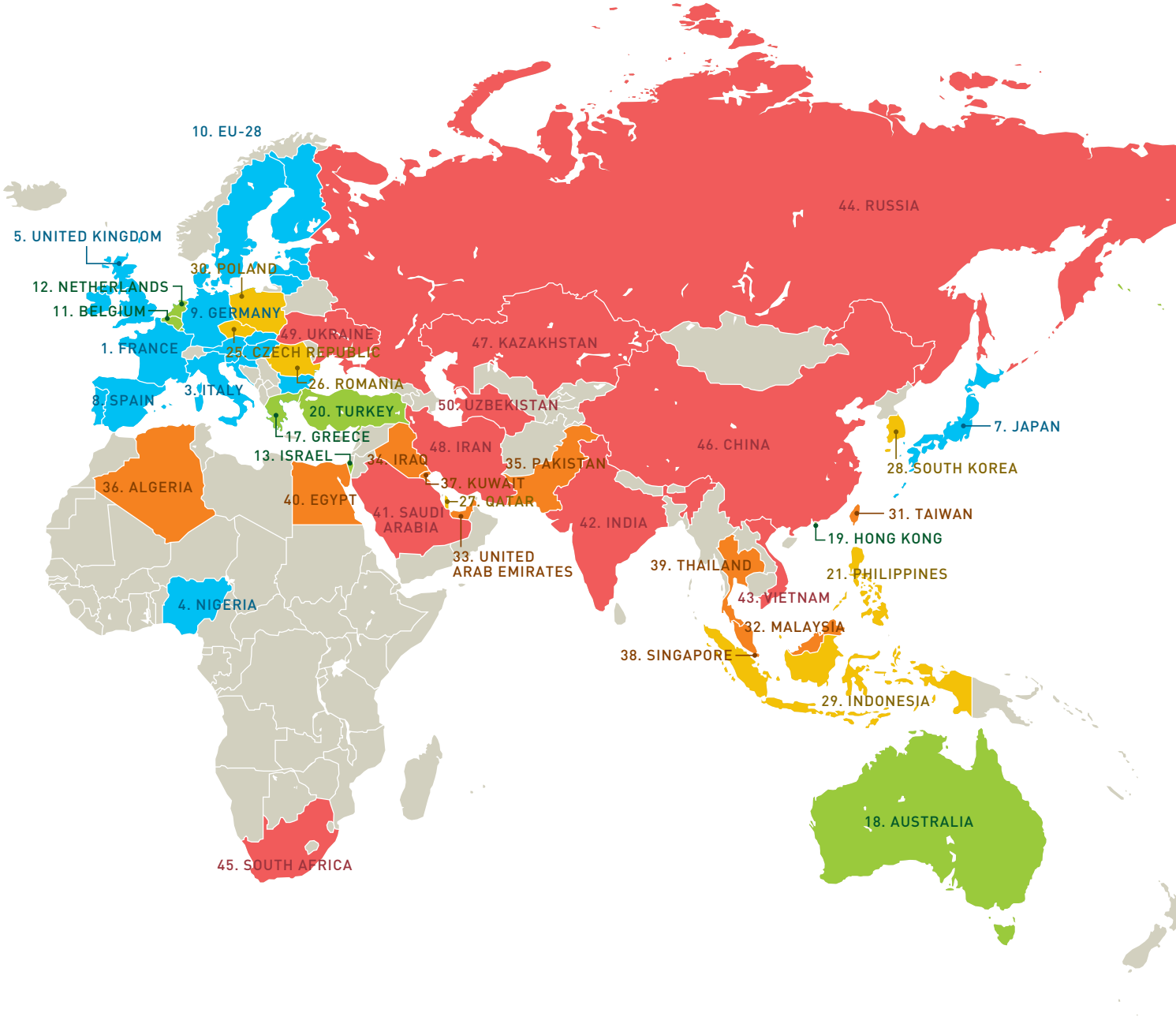


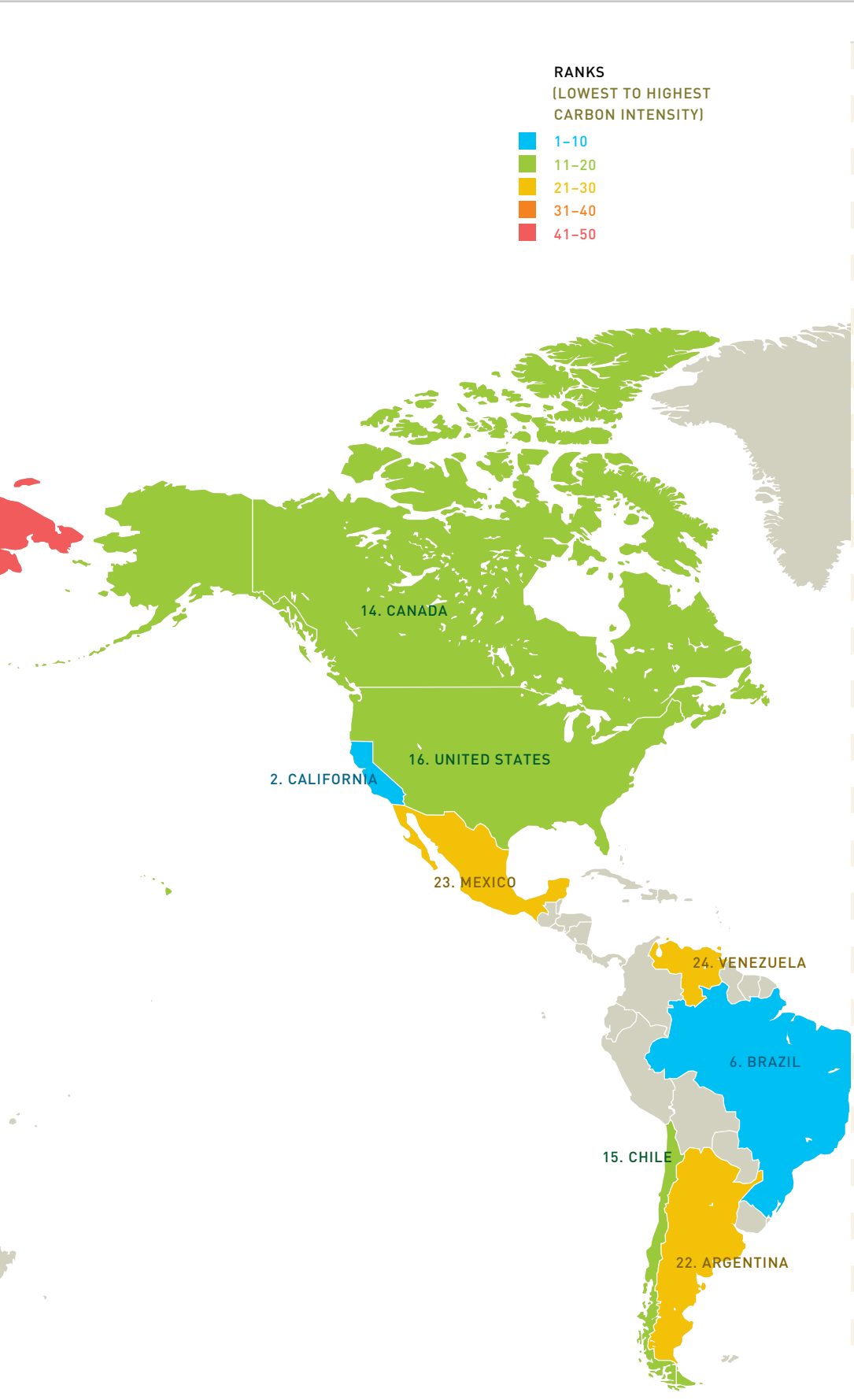
RANK	REGION	MILLION $MTCO_2e$
1	CHINA	8,547.7
2	U.S. (WITH CA)*	5,270.4
3	EU-28*	3,796.9
4	INDIA	1,830.9
5	RUSSIA	1,781.7
6	JAPAN*	1,259.1
7	GERMANY*	788.3
8	SOUTH KOREA*	657.1
9	IRAN	603.6
10	SAUDI ARABIA	582.7
11	CANADA*	550.8
12	BRAZIL	500.2
13	UNITED KINGDOM*	498.9
14	SOUTH AFRICA	473.2
15	INDONESIA	456.2
16	MEXICO*	453.8
17	AUSTRALIA*	420.6
18	ITALY*	385.8
19	FRANCE*	364.5
20	CALIFORNIA	344.9
21	SPAIN*	312.4
22	TAIWAN	307.1
23	TURKEY*	296.9
24	THAILAND	290.7
25	UKRAINE	290.4
26	POLAND*	289.5
27	NETHERLANDS*	239.6
28	UNITED ARAB EMIRATES	234.1
29	KAZAKHSTAN	224.2
30	SINGAPORE	208.0
31	EGYPT	206.3
32	MALAYSIA	198.8
33	ARGENTINA	196.0
34	VENEZUELA	184.8
35	PAKISTAN	146.9
36	BELGIUM*	139.1
37	ALGERIA	133.9
38	VIETNAM	131.7
39	IRAQ	130.7
40	UZBEKISTAN	123.2
41	KUWAIT	105.7
42	QATAR	99.2
43	CZECH REPUBLIC*	91.2
44	HONG KONG	88.6
45	GREECE*	87.6
46	NIGERIA	86.4
47	ROMANIA	86.1
48	PHILIPPINES	83.9
49	CHILE*	81.5
50	ISRAEL*	80.4

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.
NEXT 10 / SF · CA · USA

CARBON ECONOMY RANKING

CARBON INTENSITY ($MTCO_2e$/GDP) IN 2012





RANK	REGION	$MTCO_2e$ / $10,000 GDP
1	FRANCE*	1.39
2	CALIFORNIA	1.68
3	ITALY*	1.91
4	NIGERIA	2.11
5	UNITED KINGDOM*	2.14
6	BRAZIL	2.25
7	JAPAN*	2.27
8	SPAIN*	2.29
9	GERMANY*	2.29
10	EU-28*	2.29
11	BELGIUM*	2.90
12	NETHERLANDS*	3.09
13	ISRAEL*	3.21
14	CANADA*	3.27
15	CHILE*	3.36
16	U.S. (WITH CA)*	3.39
17	GREECE*	3.44
18	AUSTRALIA*	3.48
19	HONG KONG	3.64
20	TURKEY*	3.66
21	PHILIPPINES	3.80
22	ARGENTINA	3.85
23	MEXICO*	3.99
24	VENEZUELA	4.27
25	CZECH REPUBLIC*	4.56
26	ROMANIA	5.09
27	QATAR	5.28
28	SOUTH KOREA*	5.66
29	INDONESIA	5.68
30	POLAND*	5.79
31	TAIWAN	6.91
32	MALAYSIA	7.23
33	UNITED ARAB EMIRATES	7.51
34	IRAQ	7.66
35	PAKISTAN	7.75
36	ALGERIA	7.78
37	KUWAIT	7.81
38	SINGAPORE	8.09
39	THAILAND	8.46
40	EGYPT	9.06
41	SAUDI ARABIA	9.63
42	INDIA	9.67
43	VIETNAM	10.12
44	RUSSIA	10.83
45	SOUTH AFRICA	12.21
46	CHINA	12.25
47	KAZAKHSTAN	13.42
48	IRAN	13.46
49	UKRAINE	20.24
50	UZBEKISTAN	26.76

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.

NEXT 10 / SF · CA · USA

GHG EMISSIONS PER CAPITA RANKING

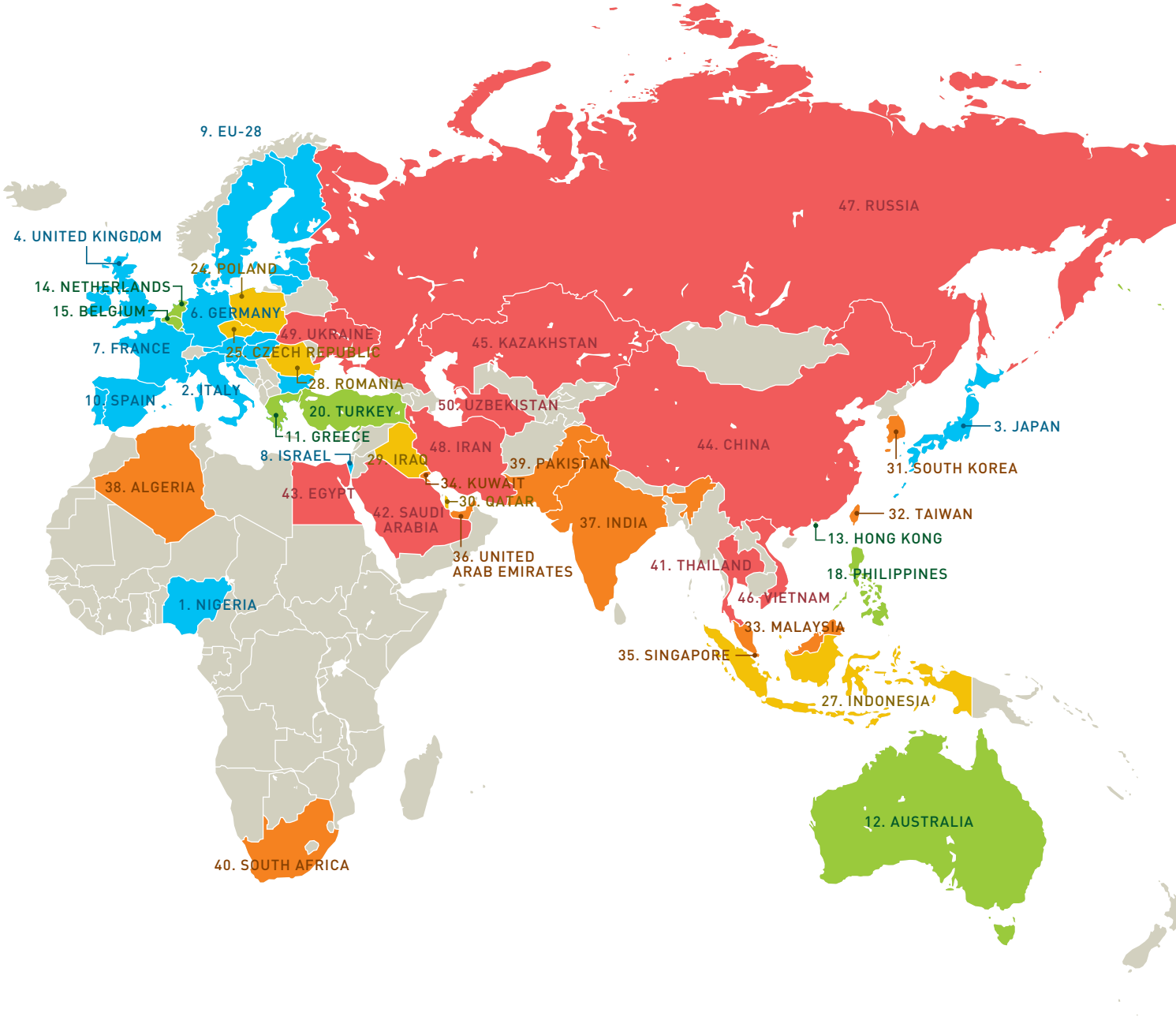
EMISSIONS PER CAPITA ($MTCO_2e$/PERSON) IN 2012

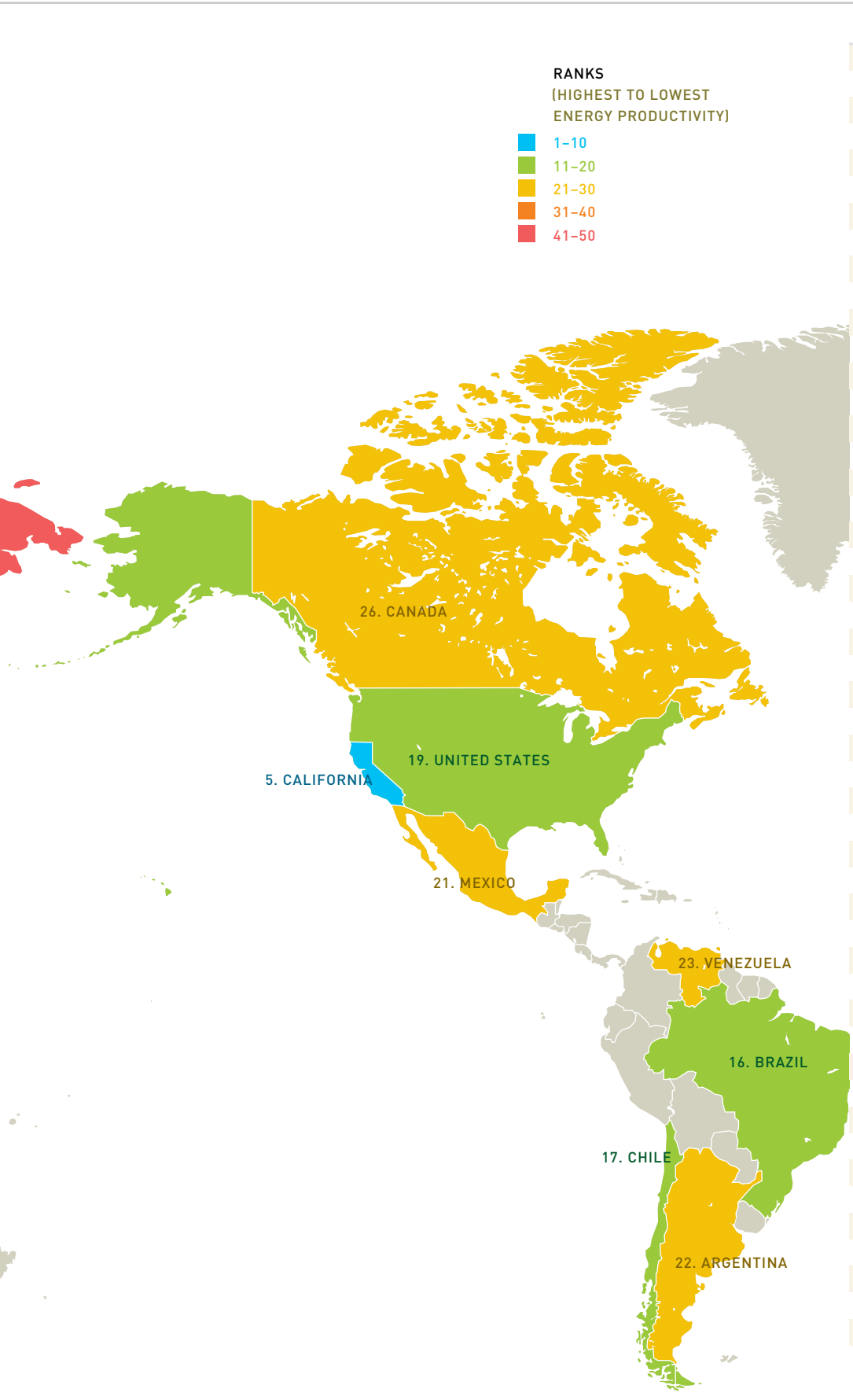
RANK	REGION	$MTCO_2e$ / PERSON
1	NIGERIA	0.51
2	PAKISTAN	0.77
3	PHILIPPINES	0.81
4	VIETNAM	1.44
5	INDIA	1.52
6	INDONESIA	1.83
7	EGYPT	2.47
8	BRAZIL	2.51
9	ALGERIA	3.58
10	TURKEY*	3.72
11	MEXICO*	3.87
12	ROMANIA	3.94
13	IRAQ	4.20
14	THAILAND	4.32
15	UZBEKISTAN	4.34
16	ARGENTINA	4.65
17	CHILE*	4.78
18	FRANCE*	5.55
19	ITALY*	6.30
20	CHINA	6.36
21	UKRAINE	6.47
22	VENEZUELA	6.59
23	SPAIN*	6.64
24	MALAYSIA	6.81
25	EU-28*	7.46
26	POLAND*	7.53
27	IRAN	7.65
28	UNITED KINGDOM*	7.91
29	GREECE*	8.13
30	CZECH REPUBLIC*	8.61
31	CALIFORNIA	9.16
32	SOUTH AFRICA	9.69
33	GERMANY*	9.70
34	JAPAN*	9.89
35	ISRAEL*	10.59
36	RUSSIA	12.50
37	HONG KONG	12.57
38	KAZAKHSTAN	12.80
39	TAIWAN	13.22
40	BELGIUM*	13.33
41	SOUTH KOREA*	13.45
42	NETHERLANDS*	14.32
43	CANADA*	16.06
44	U.S. (WITH CA)*	16.77
45	AUSTRALIA*	19.11
46	SAUDI ARABIA	21.96
47	SINGAPORE	38.85
48	KUWAIT	39.94
49	UNITED ARAB EMIRATES	44.04
50	QATAR	45.72

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.
NEXT 10 / SF · CA · USA

ENERGY PRODUCTIVITY RANKING

ENERGY PRODUCTIVITY (GDP/BTU) IN 2012





RANK	REGION	GDP / BTU
1	NIGERIA	453.0
2	ITALY*	281.2
3	JAPAN*	273.1
4	UNITED KINGDOM*	269.8
5	**CALIFORNIA**	**268.2**
6	GERMANY*	255.5
7	FRANCE*	244.9
8	ISRAEL*	239.9
9	EU-28*	229.6
10	SPAIN*	226.2
11	GREECE*	207.7
12	AUSTRALIA*	201.9
13	HONG KONG	200.5
14	NETHERLANDS*	191.7
15	BELGIUM*	184.9
16	BRAZIL	183.9
17	CHILE*	171.1
18	PHILIPPINES	169.0
19	U.S. (WITH CA)*	163.7
20	TURKEY*	160.7
21	MEXICO*	146.7
22	ARGENTINA	138.9
23	VENEZUELA	128.6
24	POLAND*	128.1
25	CZECH REPUBLIC*	127.2
26	CANADA*	126.0
27	INDONESIA	124.9
28	ROMANIA	115.8
29	IRAQ	105.2
30	QATAR	105.0
31	SOUTH KOREA*	100.8
32	TAIWAN	91.9
33	MALAYSIA	88.4
34	KUWAIT	85.7
35	SINGAPORE	82.8
36	UNITED ARAB EMIRATES	81.5
37	INDIA	79.2
38	ALGERIA	77.0
39	PAKISTAN	71.6
40	SOUTH AFRICA	68.2
41	THAILAND	66.7
42	SAUDI ARABIA	65.0
43	EGYPT	64.3
44	CHINA	63.1
45	KAZAKHSTAN	60.3
46	VIETNAM	55.9
47	RUSSIA	52.2
48	IRAN	46.5
49	UKRAINE	28.4
50	UZBEKISTAN	20.2

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.
NEXT 10 / SF · CA · USA

ENERGY PER CAPITA RANKING

TOTAL ENERGY CONSUMPTION PER CAPITA (BTU/PERSON) IN 2012

RANK	REGION	MILLION BTU / PERSON
1	NIGERIA	5.4
2	PHILIPPINES	12.6
3	PAKISTAN	13.9
4	INDIA	19.8
5	VIETNAM	25.4
6	INDONESIA	25.8
7	EGYPT	42.3
8	IRAQ	52.1
9	ALGERIA	59.8
10	BRAZIL	60.7
11	TURKEY*	63.4
12	MEXICO*	66.1
13	ROMANIA	66.9
14	THAILAND	76.6
15	UZBEKISTAN	80.2
16	CHINA	82.3
17	CHILE*	83.1
18	ARGENTINA	86.9
19	POLAND*	101.7
20	MALAYSIA	106.6
21	UKRAINE	112.5
22	GREECE*	113.8
23	SOUTH AFRICA	116.3
24	ITALY*	117.1
25	VENEZUELA	119.9
26	IRAN	122.3
27	SPAIN*	128.2
28	UNITED KINGDOM*	136.9
29	ISRAEL*	137.5
30	EU-28*	141.6
31	CZECH REPUBLIC*	148.4
32	KAZAKHSTAN	158.0
33	JAPAN*	159.4
34	FRANCE*	162.9
35	GERMANY*	165.6
36	HONG KONG	172.1
37	**CALIFORNIA**	**202.8**
38	TAIWAN	208.2
39	RUSSIA	221.2
40	SOUTH KOREA*	235.8
41	NETHERLANDS*	241.8
42	BELGIUM*	248.2
43	AUSTRALIA*	272.1
44	U.S. (WITH CA)*	302.5
45	SAUDI ARABIA	351.0
46	CANADA*	389.3
47	SINGAPORE	580.1
48	KUWAIT	597.0
49	UNITED ARAB EMIRATES	719.4
50	QATAR	824.7

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.

NEXT 10 / SF · CA · USA

ELECTRICITY PER CAPITA RANKING

ELECTRICITY CONSUMPTION PER CAPITA (kWh/PERSON) IN 2012

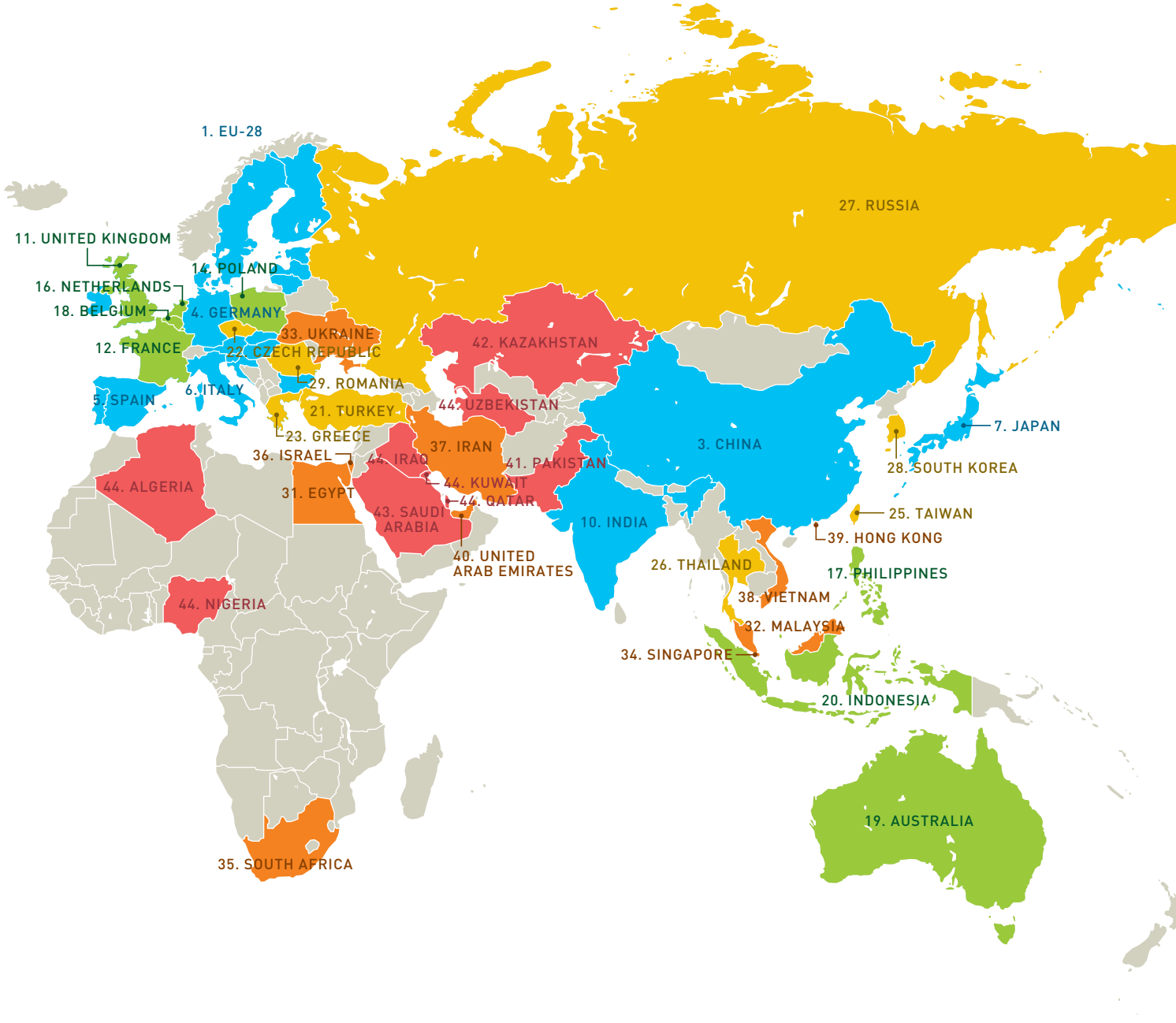
RANK	REGION	THOUSANDS OF kWh / PERSON
1	NIGERIA	0.1
2	PAKISTAN	0.4
3	PHILIPPINES	0.6
4	INDONESIA	0.7
5	INDIA	0.7
6	ALGERIA	1.1
7	VIETNAM	1.2
8	IRAQ	1.4
9	UZBEKISTAN	1.6
10	EGYPT	1.6
11	MEXICO*	2.0
12	ROMANIA	2.1
13	THAILAND	2.3
14	BRAZIL	2.4
15	TURKEY*	2.5
16	IRAN	2.5
17	ARGENTINA	2.8
18	CHINA	3.3
19	VENEZUELA	3.5
20	UKRAINE	3.6
21	POLAND*	3.6
22	CHILE*	3.7
23	MALAYSIA	4.1
24	SOUTH AFRICA	4.3
25	KAZAKHSTAN	4.6
26	ITALY*	4.9
27	UNITED KINGDOM*	5.1
28	SPAIN*	5.2
29	GREECE*	5.4
30	EU-28*	5.7
31	CZECH REPUBLIC*	5.7
32	HONG KONG	5.8
33	RUSSIA	6.2
34	NETHERLANDS*	6.4
35	GERMANY*	6.6
36	FRANCE*	6.9
37	**CALIFORNIA**	**6.9**
38	ISRAEL*	7.0
39	JAPAN*	7.2
40	BELGIUM*	7.8
41	SINGAPORE	8.2
42	SAUDI ARABIA	8.7
43	TAIWAN	9.7
44	SOUTH KOREA*	9.9
45	AUSTRALIA*	10.1
46	U.S. (WITH CA)*	12.2
47	QATAR	14.1
48	CANADA*	15.3
49	UNITED ARAB EMIRATES	17.6
50	KUWAIT	18.9

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.

NEXT 10 / SF · CA · USA

TOTAL RENEWABLE ELECTRICITY GENERATION RANKING

TOTAL RENEWABLE ELECTRICITY IN 2012



RANK	REGION	BILLIONS OF kWh OF RENEWABLE ENERGY
1	EU-28*	430.1
2	U.S. (WITH CA)*	232.1
3	CHINA	147.2
4	GERMANY*	121.7
5	SPAIN*	66.4
6	ITALY*	50.3
7	JAPAN*	47.6
8	**CALIFORNIA**	**46.5**
9	BRAZIL	40.3
10	INDIA	35.4
11	UNITED KINGDOM*	35.0
12	FRANCE*	24.6
13	CANADA*	20.6
14	POLAND*	14.9
15	MEXICO*	12.3
16	NETHERLANDS*	12.0
17	PHILIPPINES	10.5
18	BELGIUM*	10.1
19	AUSTRALIA*	9.9
20	INDONESIA	9.6
21	TURKEY*	7.4
22	CZECH REPUBLIC*	5.9
23	GREECE*	5.7
24	CHILE*	5.3
25	TAIWAN	5.1
26	THAILAND	5.0
27	RUSSIA	3.5
28	SOUTH KOREA*	3.2
29	ROMANIA	2.9
30	ARGENTINA	2.8
31	EGYPT	1.5
32	MALAYSIA	0.9
33	UKRAINE	0.8
34	SINGAPORE	0.6
35	SOUTH AFRICA	0.4
36	ISRAEL*	0.4
37	IRAN	0.2
38	VIETNAM	0.1
39	HONG KONG	0.1
40	UNITED ARAB EMIRATES	0.019
41	PAKISTAN	0.018
42	KAZAKHSTAN	0.003
43	SAUDI ARABIA	0.001
44	VENEZUELA	0.0
44	ALGERIA	0.0
44	IRAQ	0.0
44	UZBEKISTAN	0.0
44	KUWAIT	0.0
44	QATAR	0.0
44	NIGERIA	0.0

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
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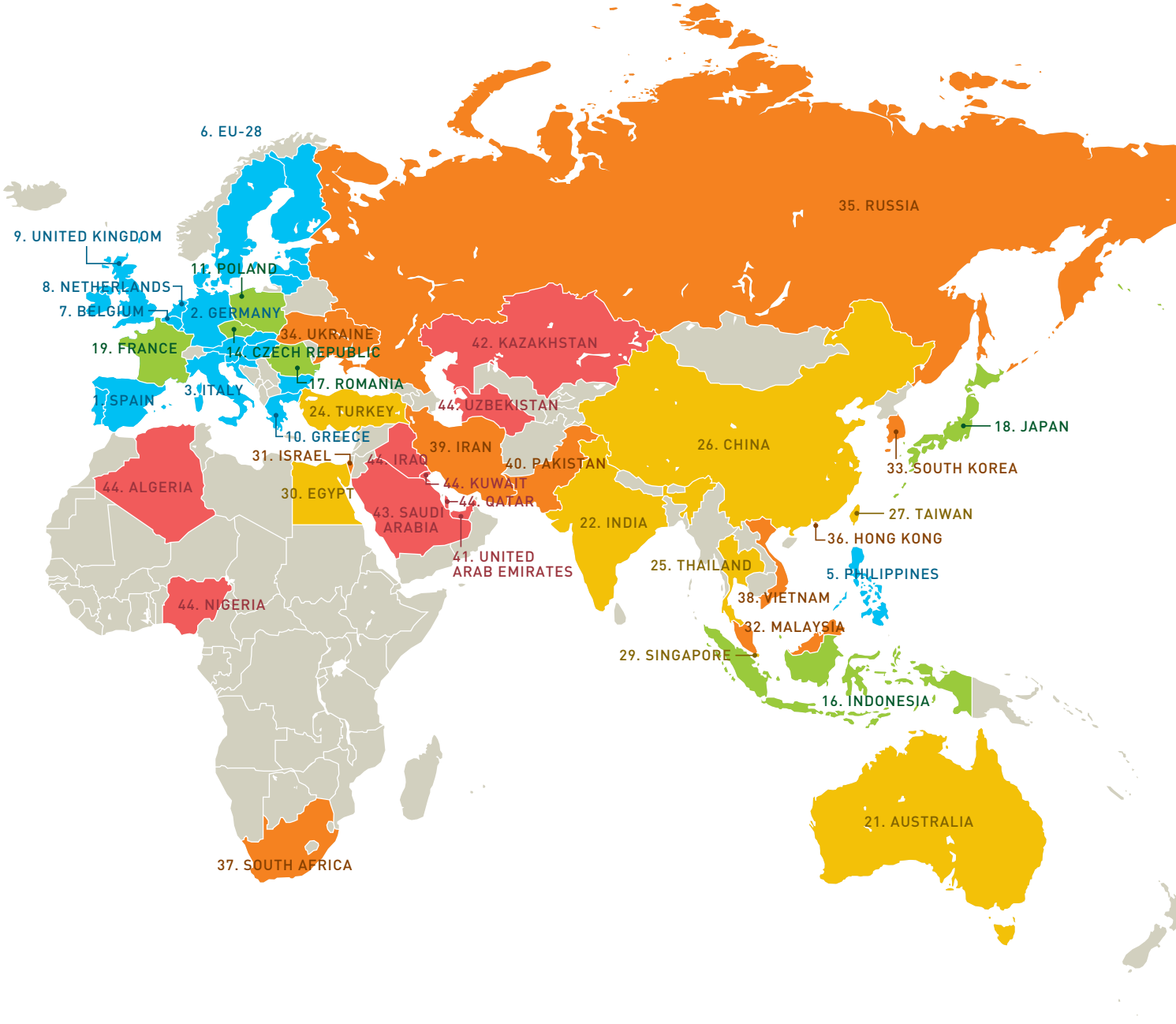
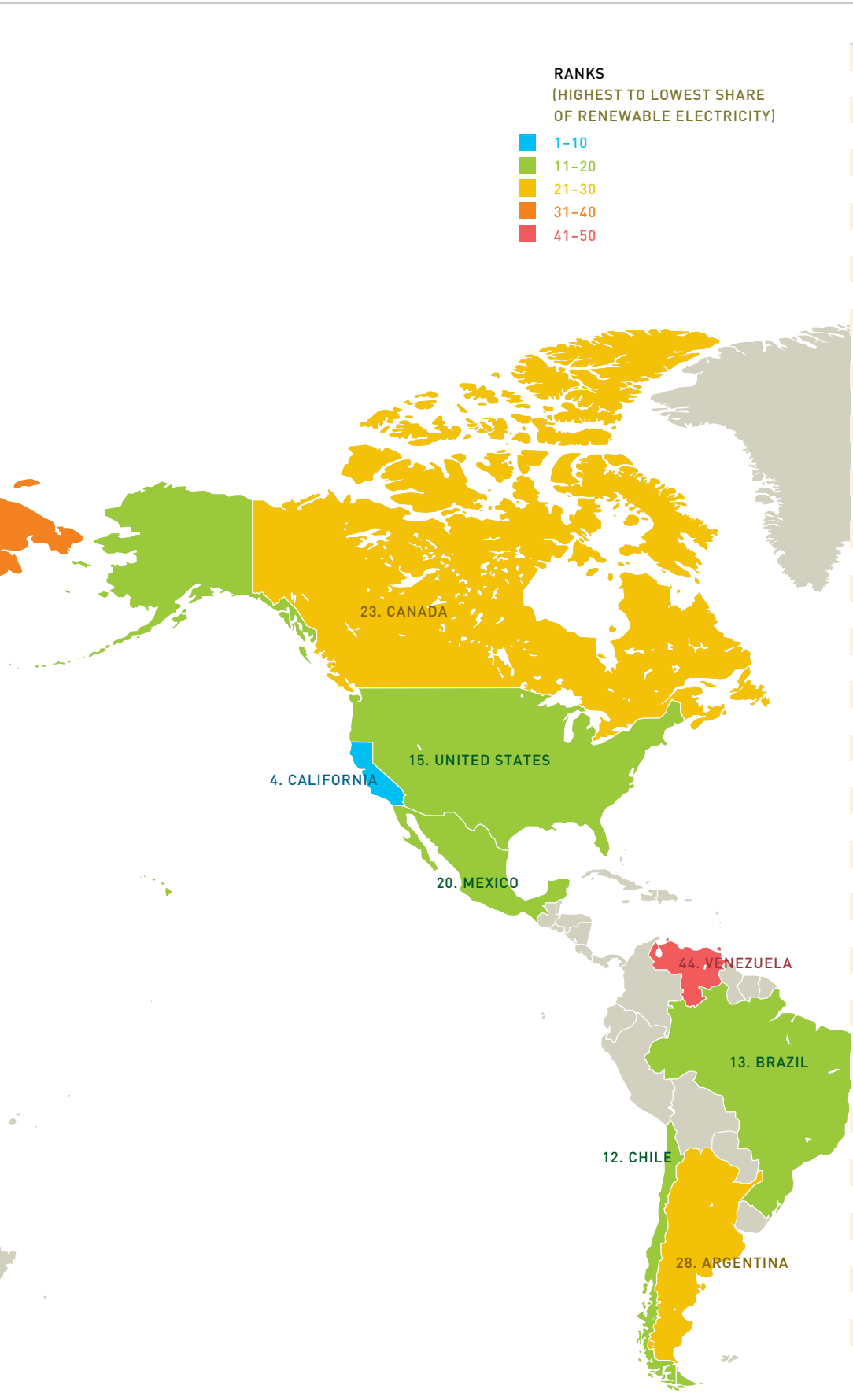
NEXT 10 / SF · CA · USA

SHARE OF ELECTRICITY FROM RENEWABLE SOURCES RANKING

SHARE OF RENEWABLES (RENEWABLE ELECTRICITY/TOTAL ELECTRICITY) IN 2012



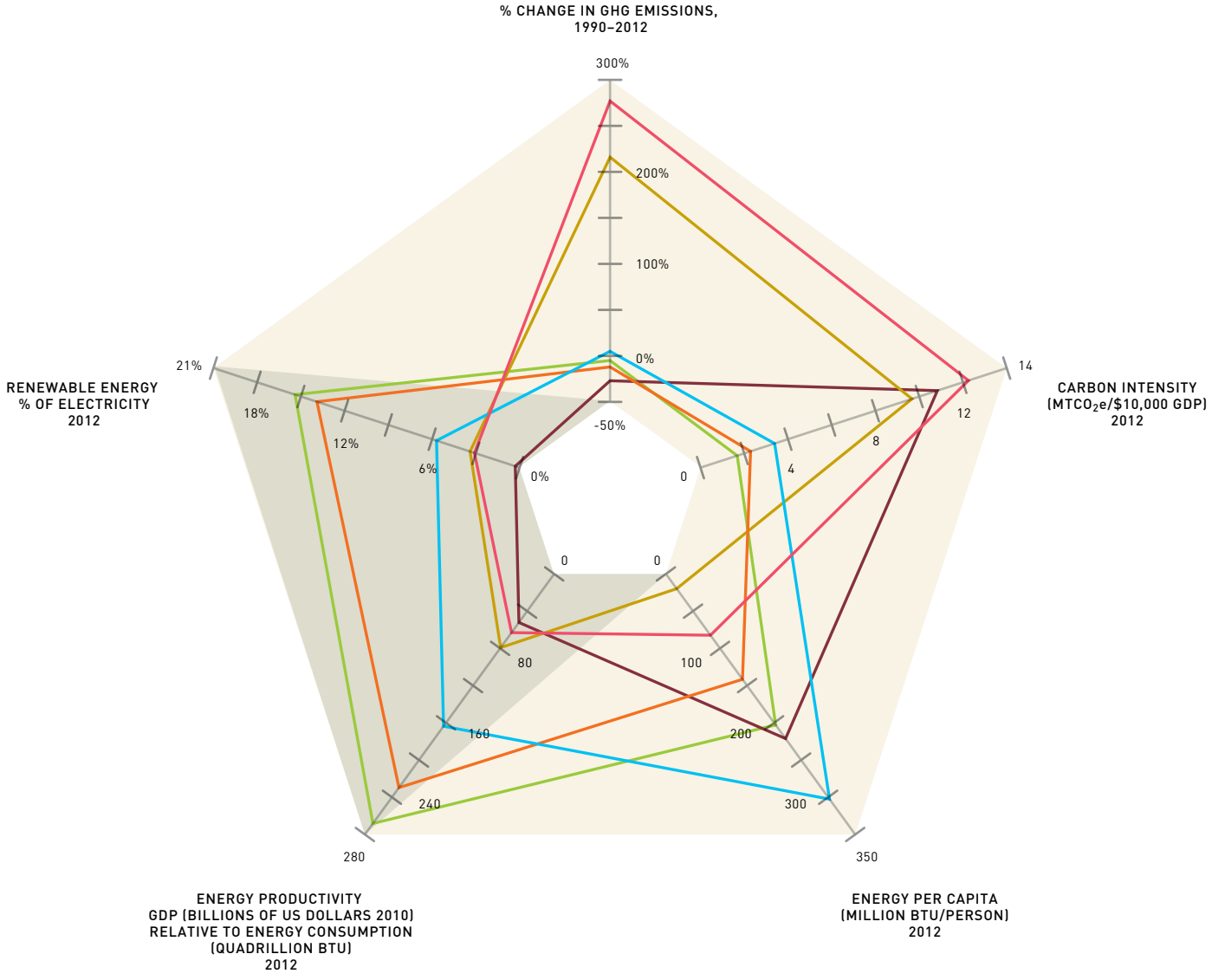


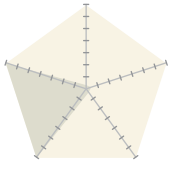
RANK	REGION	% ELECTRICITY FROM RENEWABLES
1	SPAIN*	23.7%
2	GERMANY*	20.8%
3	ITALY*	17.9%
4	**CALIFORNIA**	**15.4%**
5	PHILIPPINES	15.1%
6	EU-28*	13.9%
7	BELGIUM*	13.3%
8	NETHERLANDS*	12.6%
9	UNITED KINGDOM*	10.4%
10	GREECE*	10.0%
11	POLAND*	9.7%
12	CHILE*	7.9%
13	BRAZIL	7.5%
14	CZECH REPUBLIC*	7.2%
15	U.S. (WITH CA)*	5.7%
16	INDONESIA	5.2%
17	ROMANIA	5.1%
18	JAPAN*	4.9%
19	FRANCE*	4.6%
20	MEXICO*	4.4%
21	AUSTRALIA*	4.2%
22	INDIA	3.4%
23	CANADA*	3.3%
24	TURKEY*	3.2%
25	THAILAND	3.2%
26	CHINA	3.1%
27	TAIWAN	2.2%
28	ARGENTINA	2.1%
29	SINGAPORE	1.4%
30	EGYPT	1.0%
31	ISRAEL*	0.7%
32	MALAYSIA	0.7%
33	SOUTH KOREA*	0.6%
34	UKRAINE	0.4%
35	RUSSIA	0.3%
36	HONG KONG	0.2%
37	SOUTH AFRICA	0.2%
38	VIETNAM	0.1%
39	IRAN	0.1%
40	PAKISTAN	0.02%
41	UNITED ARAB EMIRATES	0.02%
42	KAZAKHSTAN	0.003%
43	SAUDI ARABIA	0.0004%
44	VENEZUELA	0.0%
44	ALGERIA	0.0%
44	IRAQ	0.0%
44	UZBEKISTAN	0.0%
44	KUWAIT	0.0%
44	QATAR	0.0%
44	NIGERIA	0.0%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX.
*OECD Member Countries. Analysis and data sources the same as in previous sections; rankings are out of the top 50 polluters of GHG emissions from energy consumption.
NEXT 10 / SF · CA · USA

SUMMARY OF THE TOP FIVE GREENHOUSE GAS EMITTERS AND CALIFORNIA

REGION	CHINA	U.S. (WITH CA)	EU-28	INDIA	RUSSIA	CALIFORNIA
RANK OF GHG EMISSIONS FROM ENERGY CONSUMPTION, 2012	1	2	3	4	5	20
GDP PER CAPITA, 2013	$6,816	$52,616	$35,110	$1,518	$14,717	$58,016

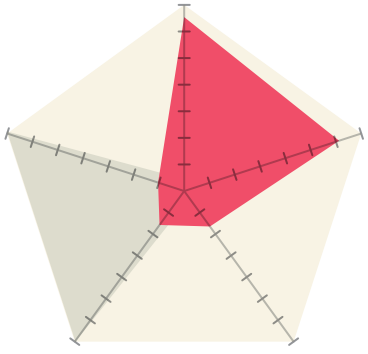




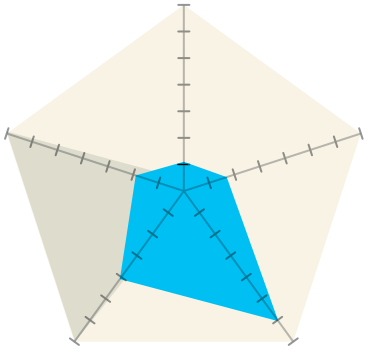
HOW TO READ THE RADAR CHART:

IN THIS RADAR CHART, THE GOAL IS TO BE CLOSER TO THE OUTER EDGE FOR RENEWABLE ENERGY AND ENERGY PRODUCTIVITY, AND CLOSER TO THE CENTER FOR ENERGY PER CAPITA, CARBON INTENSITY, AND % CHANGE IN GHG EMISSIONS.

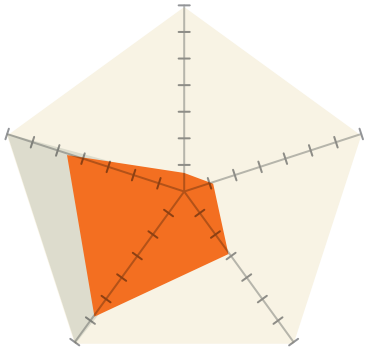
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. NEXT 10 / SF · CA · USA



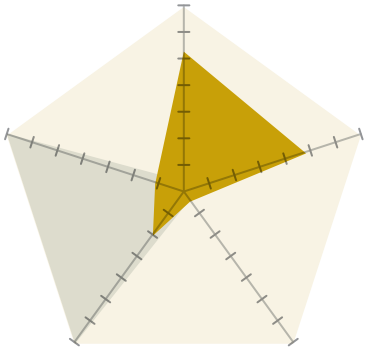
CHINA



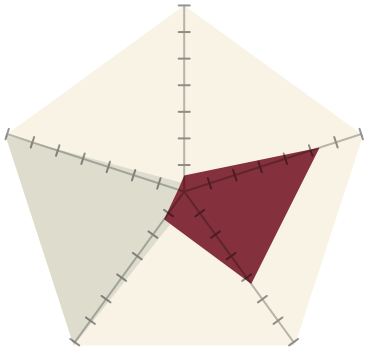
U.S. (WITH CA)



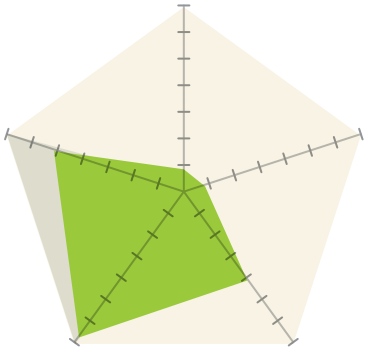
EU-28



INDIA



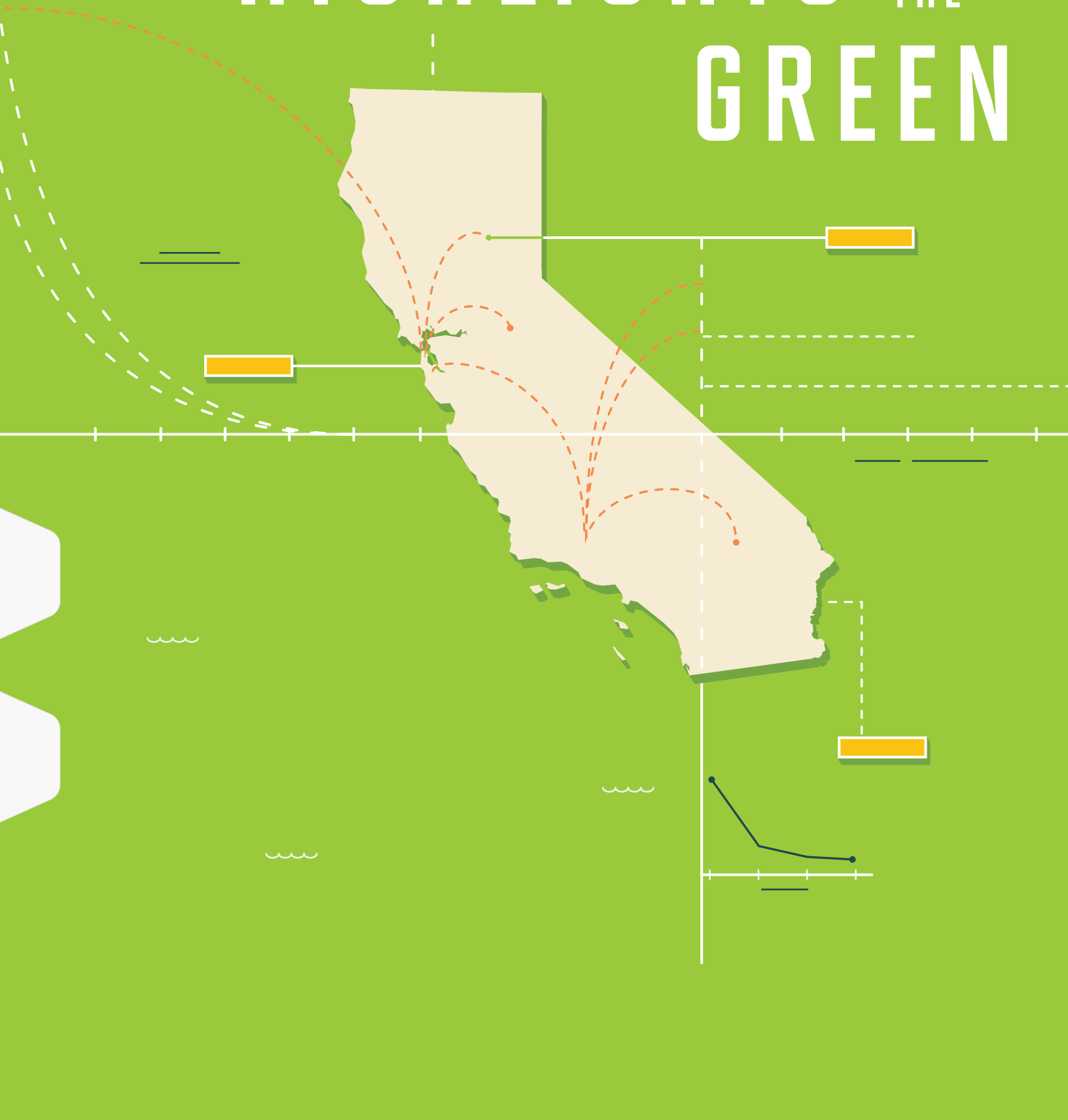
RUSSIA



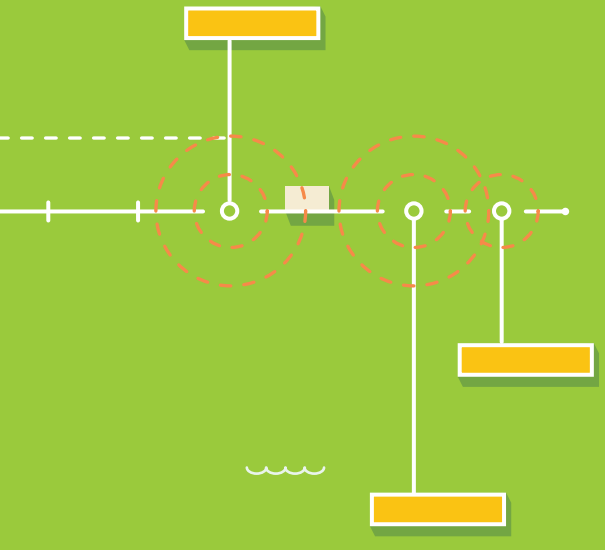
CALIFORNIA

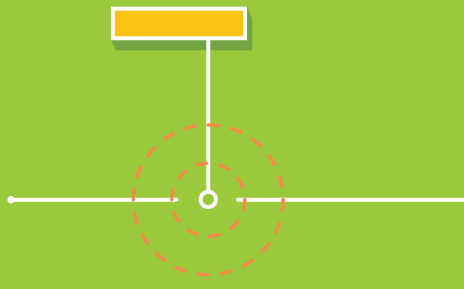
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. NEXT 10 / SF · CA · USA

HIGHLIGHTS FROM THE GREEN



CALIFORNIA INNOVATION INDEX





California's progress in growing its clean technology economy demonstrates that economic prosperity and environmental protection are not mutually exclusive concepts. The state has a long history of innovative environmental and energy policies and programs, dating back to the 1970s. California's historic Global Warming Solutions Act of 2006 (AB 32) set a target of reaching 1990 emissions levels by the year 2020, and the state established strong supportive actions such as an economy-wide cap-and-trade system, renewable energy targets, emissions standards for power plants and vehicles, the Low Carbon Fuel Standard, and other policies. In April 2015, California set an ambitious new target of reducing GHG emissions 40 percent below 1990 levels by 2030. In addition, California is working directly with countries, U.S. states, and other sub-national entities to share and leverage its experience.

The state of California ranks among the most efficient developed countries and least carbon intensive economies in the world, and has achieved improvements in energy efficiency while lowering energy bills for consumers. Renewable energy installations and generation in the state continue to surpass previous year records. California also leads in clean technology innovation, with its companies receiving the most investment and patents in the nation, and more than many countries. This innovation, along with progressive policies, drives the state's progress in developing and implementing clean technology products and services.

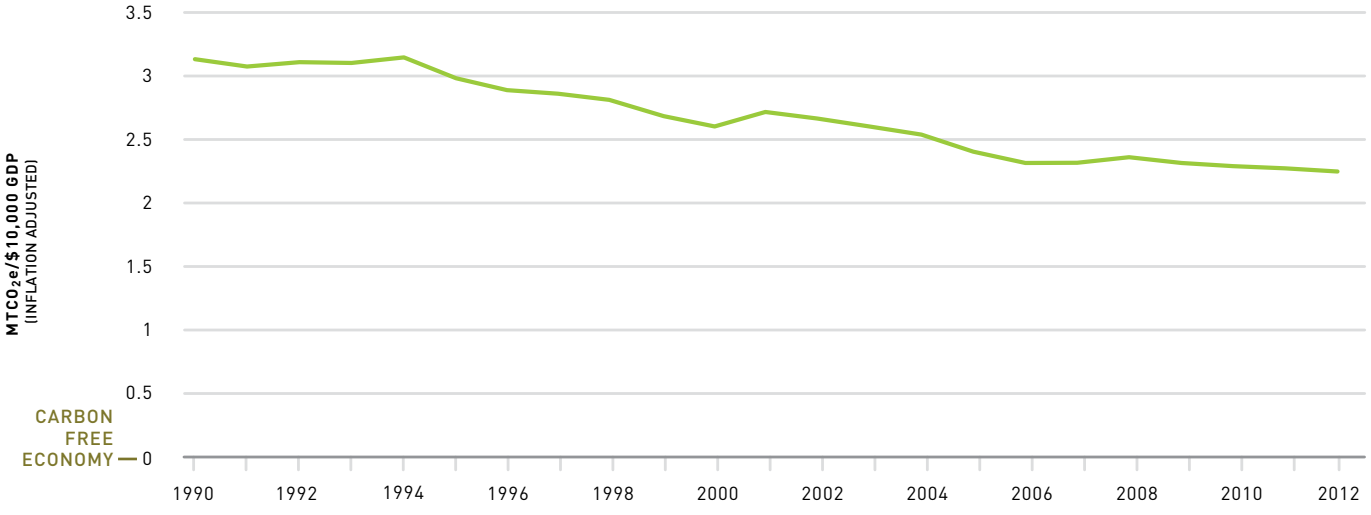
CARBON ECONOMY

California has achieved economic growth while becoming more energy efficient. The state's carbon intensity (emissions per GDP) steadily declined since 1990 and was 28 percent lower in 2012 (Figure 29). From 2011 to 2012, the state's carbon intensity decreased 1.1 percent to 2.26 $MTCO_2e$ carbon emissions per $10,000 of GDP generated.

California's GHG emissions per capita improved over time with a 17 percent decrease between 1990 and 2012, while the state's economy (GDP per capita) increased 16 percent (Figure 30). California's emissions per capita increased slightly (+1.1%) between 2011 and 2012, though at a slower rate than GDP per capita (+2.2%).

FIGURE 29. THE CARBON ECONOMY

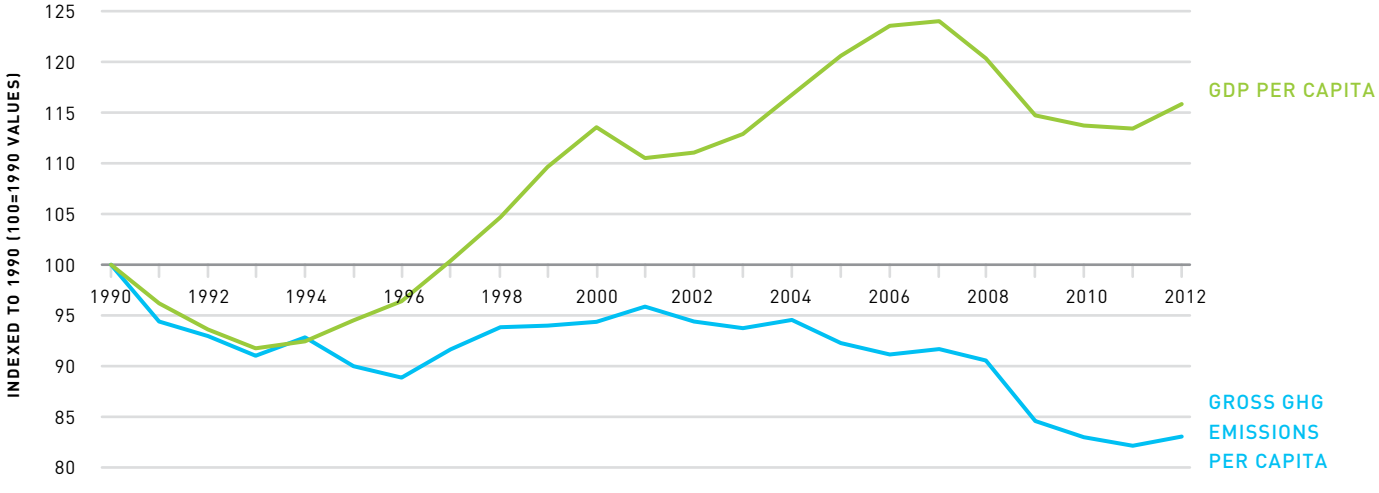
GREENHOUSE GAS EMISSIONS RELATIVE TO GDP, CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: California GHG emissions that allow for country/regional comparison are from the U.S. Energy Information Administration and limited to carbon emissions from energy consumption, therefore these values differ from previous charts. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity; U.S. Bureau of Economic Analysis. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 30. GREENHOUSE GAS EMISSIONS AND GROSS DOMESTIC PRODUCT

CALIFORNIA RELATIVE TRENDS SINCE 1990: GREENHOUSE GAS EMISSIONS ($MTCO_2e$) AND GDP DOLLARS, PER CAPITA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: California GHG emissions that allow for country/regional comparison are from the U.S. Energy Information Administration and limited to carbon emissions from energy consumption, therefore these values differ from previous charts. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity; U.S. Bureau of Economic Analysis; California Department of Finance. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

ENERGY EFFICIENCY

California's energy productivity (GDP relative to energy consumption) improved 70 percent since 1990, compared to 51 percent in the rest of the U.S. (Figure 31). Energy productivity in the state increased 5.6 percent from 2011 to 2012, representing the largest jump since 2000.

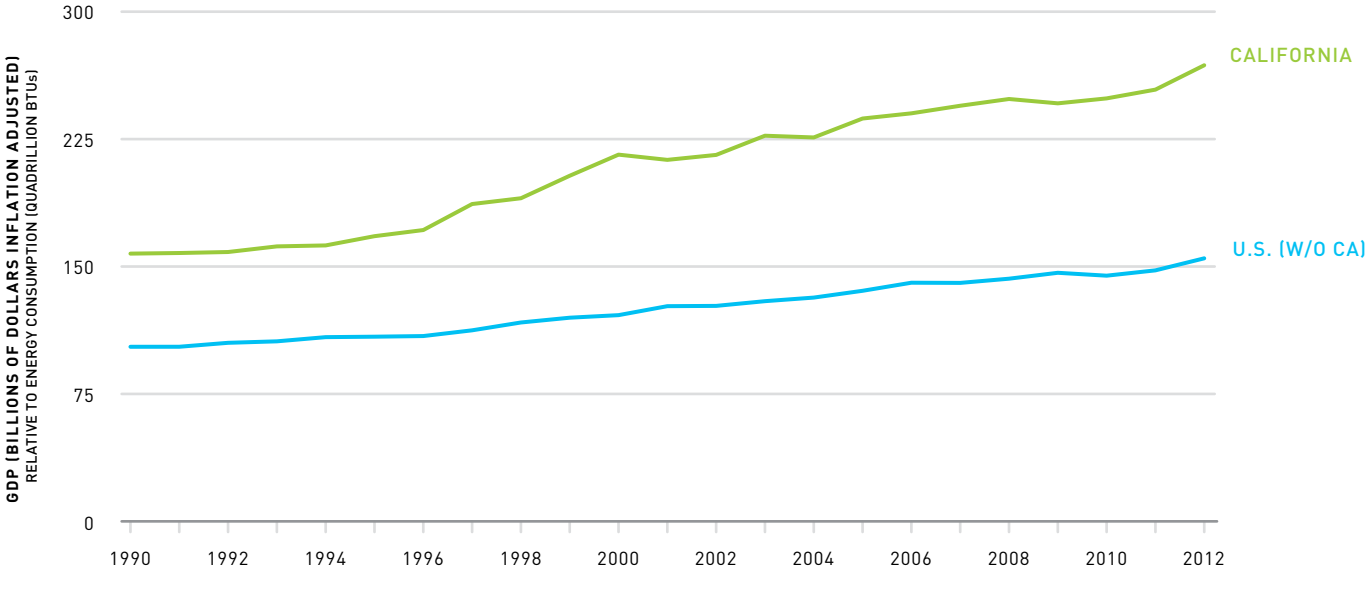
California has become more efficient with electricity use even while total consumption increased. Per capita consumption in 2012 is 4 percent below 1990 levels, while the rest of the U.S. rose 8 percent over the same time (Figure 32). After increasing slightly in 2012, per capita consumption fell 1.5 percent in 2012.

California's statewide electricity bill as a share of its GDP remains lower than the U.S. as a whole and states with comparable economies and populations, equating to 1.7 percent of the state's GDP in 2013 (Figure 33). In comparison, Florida's electricity bill was 2.8 percent of its GDP, Texas's bill was 2.1 percent, and New York's bill was 1.7 percent.

California consumers are benefiting from the state's efficiency policies through lower monthly bills. While average electricity rates per kilowatt hour in the state are higher than the national average, the average monthly bill for the residential and industrial sectors were 22 and 25 percent lower, respectively, compared to the U.S. as a whole. The commercial sector in California, in contrast, was 21 percent higher than the national average in 2013 (Table 22). When factoring in cost of living adjustments, California's residential sector has even lower average monthly bills when compared to states with comparable economies and climate zones (Table 23).

FIGURE 31. ENERGY PRODUCTIVITY

GDP RELATIVE TO TOTAL ENERGY CONSUMPTION: CALIFORNIA AND THE REST OF THE U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Bureau of Economic Analysis. Analysis: Collaborative Economics.

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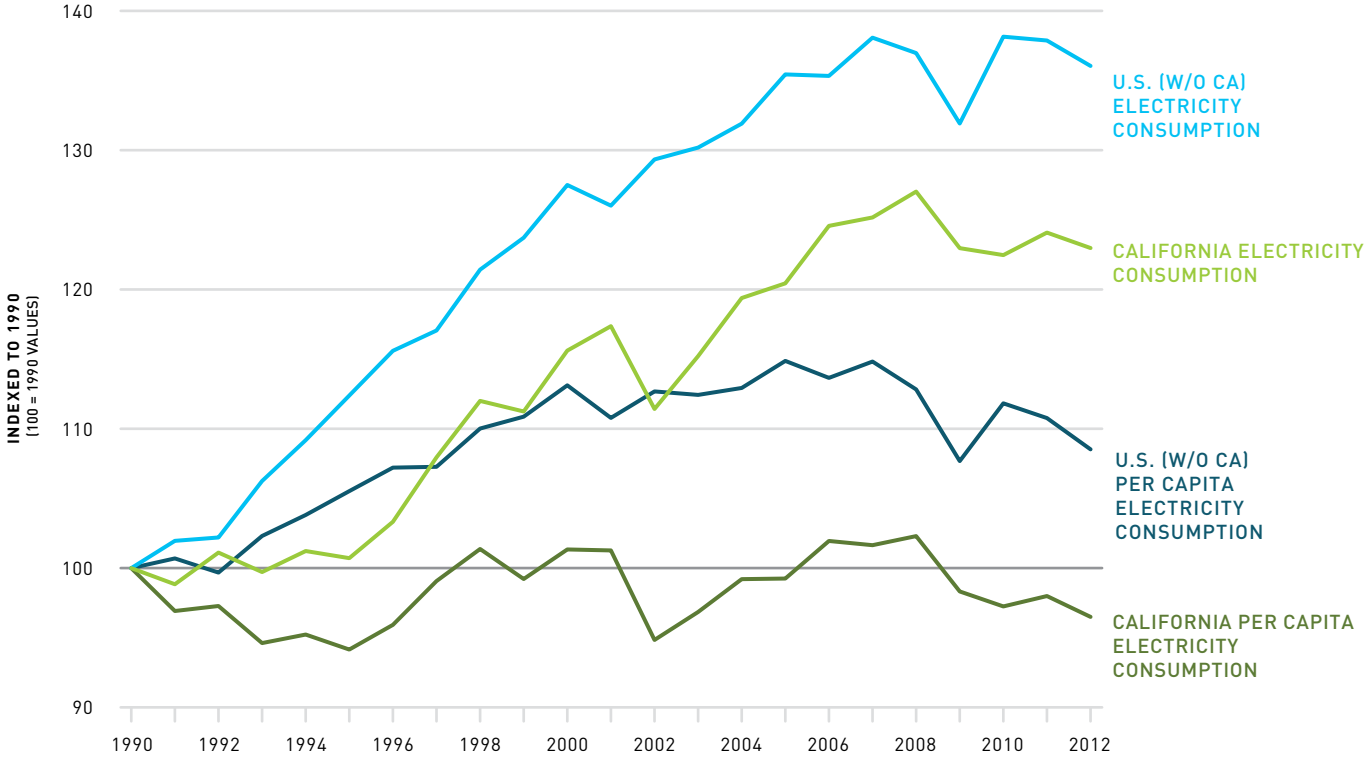
FIGURE 32. ENERGY CONSUMPTION RELATIVE TO 1990

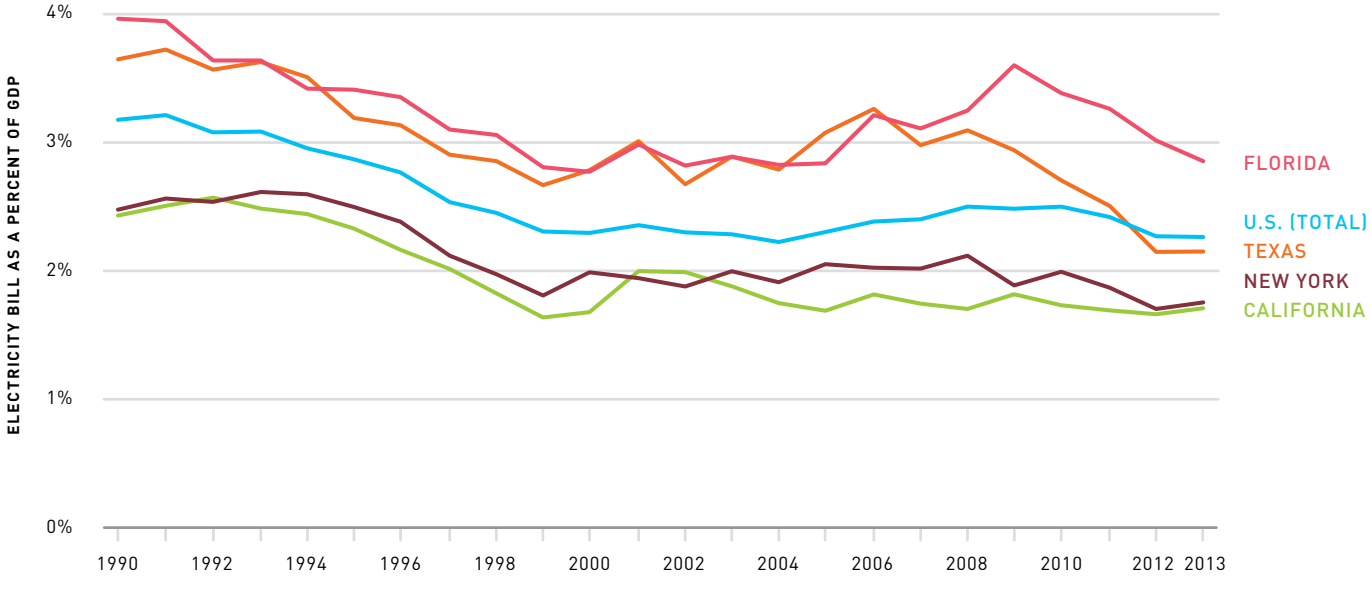
TOTAL CONSUMPTION AND PER CAPITA: CALIFORNIA AND THE REST OF THE U.S.



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; California Department of Finance, U.S. Census Bureau. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 33. STATEWIDE ELECTRICITY BILL AS A PERCENT OF GDP

CALIFORNIA, U.S. TOTAL, FLORIDA, TEXAS, AND NEW YORK, 1990–2013



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy, Energy Information Administration, U.S. Bureau of Economic Analysis. Analysis: Collaborative Economics.
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TABLE 22. ELECTRICITY PRICES AND BILLS (INFLATION ADJUSTED) BY SECTOR

	REGION	PRICE PER kWh	AVERAGE MONTHLY BILL		
		2013	1993	2013	% CHANGE 1993–2013
RESIDENTIAL	CALIFORNIA	$0.16	$94.34	$90.19	-4%
	UNITED STATES (TOTAL)	$0.12	$110.31	$110.21	0%
	NEW YORK	$0.19	$110.35	$113.16	3%
	FLORIDA	$0.11	$132.98	$121.53	-9%
	TEXAS	$0.11	$138.05	$133.33	-3%
INDUSTRIAL	CALIFORNIA	$0.11	$14,230	$6,051	-57%
	UNITED STATES (TOTAL)	$0.07	$11,500	$7,537	-34%
	NEW YORK	$0.07	$22,538	$12,347	-45%
	FLORIDA	$0.08	$5,271	$5,716	10%
	TEXAS	$0.06	$8,661	$5,145	-41%
COMMERCIAL	CALIFORNIA	$0.14	$758.61	$819.02	8%
	UNITED STATES (TOTAL)	$0.10	$659.82	$649.22	-2%
	NEW YORK	$0.15	$914.27	$938.88	3%
	FLORIDA	$0.09	$657.27	$613.25	-7%
	TEXAS	$0.08	$677.64	$667.29	-2%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy; Energy Information Administration; Inflation adjusted with Bureau of Labor Statistics Consumer Price Index for All Urban Consumers. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TABLE 23. RESIDENTIAL ELECTRICITY BILLS AND PRICES

REGION	PRICE PER kWh	AVERAGE MONTHLY BILL	AVERAGE MONTHLY BILL ADJUSTED FOR COST OF LIVING
	2013	2013	2013
CALIFORNIA	$0.16	$ 90.19	$ 70.08
UNITED STATES (TOTAL)	$0.12	$110.21	$113.04
NEW YORK	$0.19	$113.16	$ 84.96
FLORIDA	$0.11	$121.53	$121.78
TEXAS	$0.11	$133.33	$143.67
NORTH CAROLINA	$0.11	$120.52	$124.89
ARIZONA	$0.12	$122.85	$122.60
GEORGIA	$0.11	$124.67	$134.20

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Department of Energy, Energy Information Administration; Adjusted for Cost of Living from the Missouri Economic Research and Information Center. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

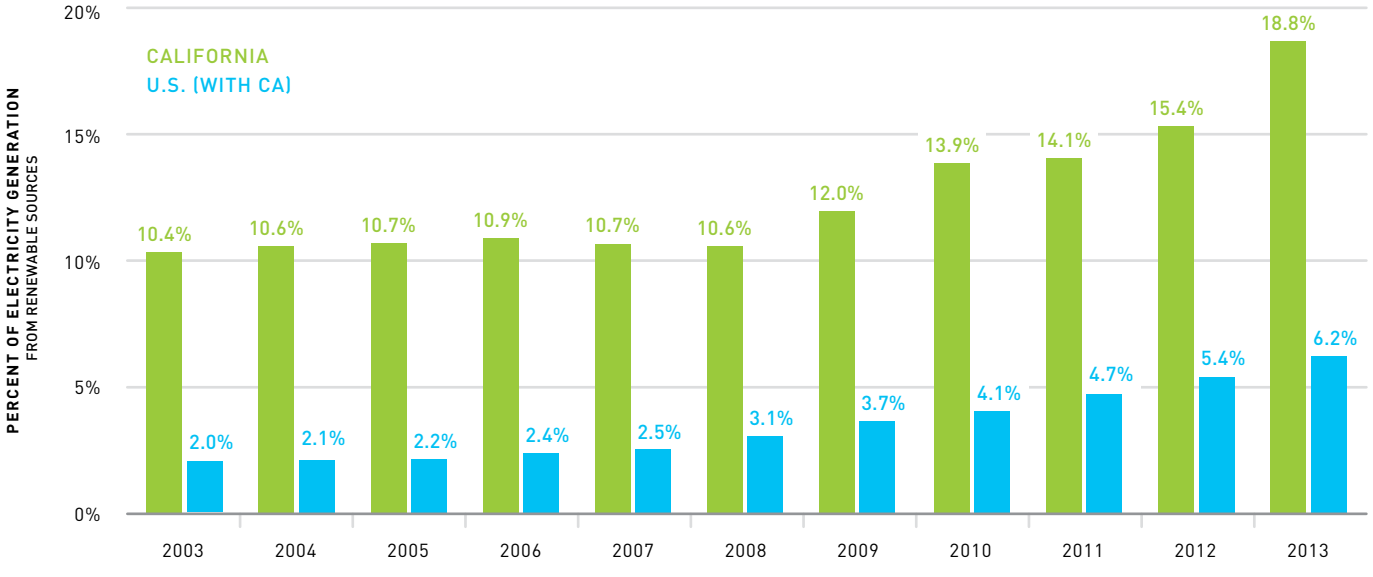
RENEWABLE ENERGY

The share of California's total electricity generation from renewable sources reached an all time high of 18.8 percent in 2013, and rose to 23 percent as of May 2014 (Figure 34). While the U.S. also increased its share of renewable electricity over the long-term, it remains only a third of California's levels.

California's renewable electricity generation increased 94 percent since 2003, reaching nearly 55,700 gigawatt hours in 2013 (Figure 35). A large jump in wind generation (+33%) accounted for much of the increased generation between 2012 and 2013.

FIGURE 34. PERCENT OF TOTAL ELECTRICITY GENERATION FROM RENEWABLE SOURCES

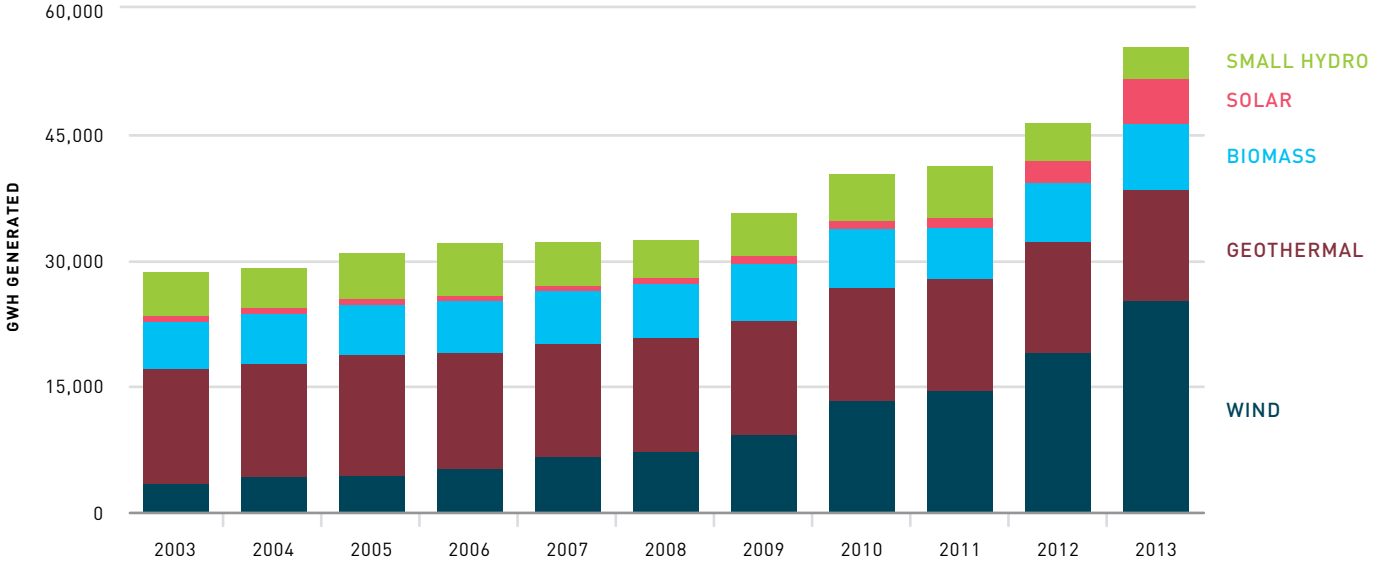
CALIFORNIA AND UNITED STATES



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Renewables do not include large hydro. Data Source: California Energy Commission and U.S. Energy Information Administration. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 35. CALIFORNIA RENEWABLE ELECTRICITY GENERATION

GIGAWATT HOURS BY SOURCE

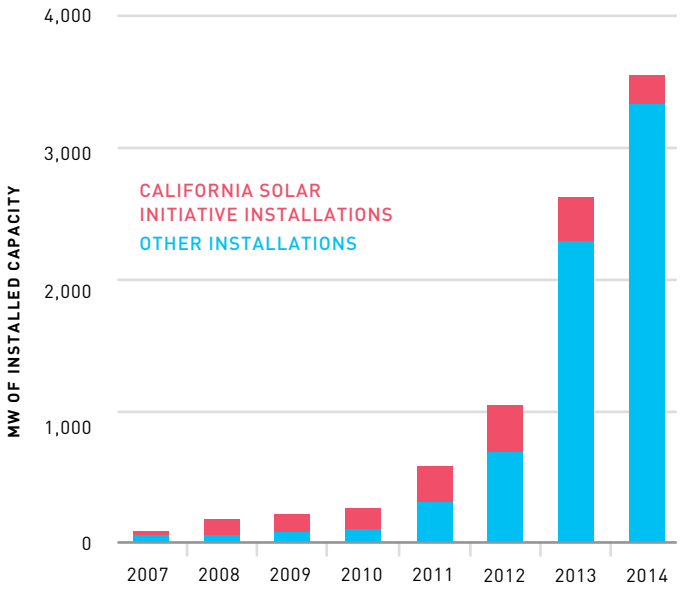


NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

New annual solar installations reached more than 3,500 MW in 2014, more than 40 times higher than 2007 levels (Figure 36). Installations through the California Solar Initiative program helped jumpstart the state's solar market and accounted for most of the installations between 2007 and 2010, while larger utility scale installations made up the majority in recent years. In 2014, California brought online the Topaz Solar Farm project, which is currently the largest solar power plant in the world.

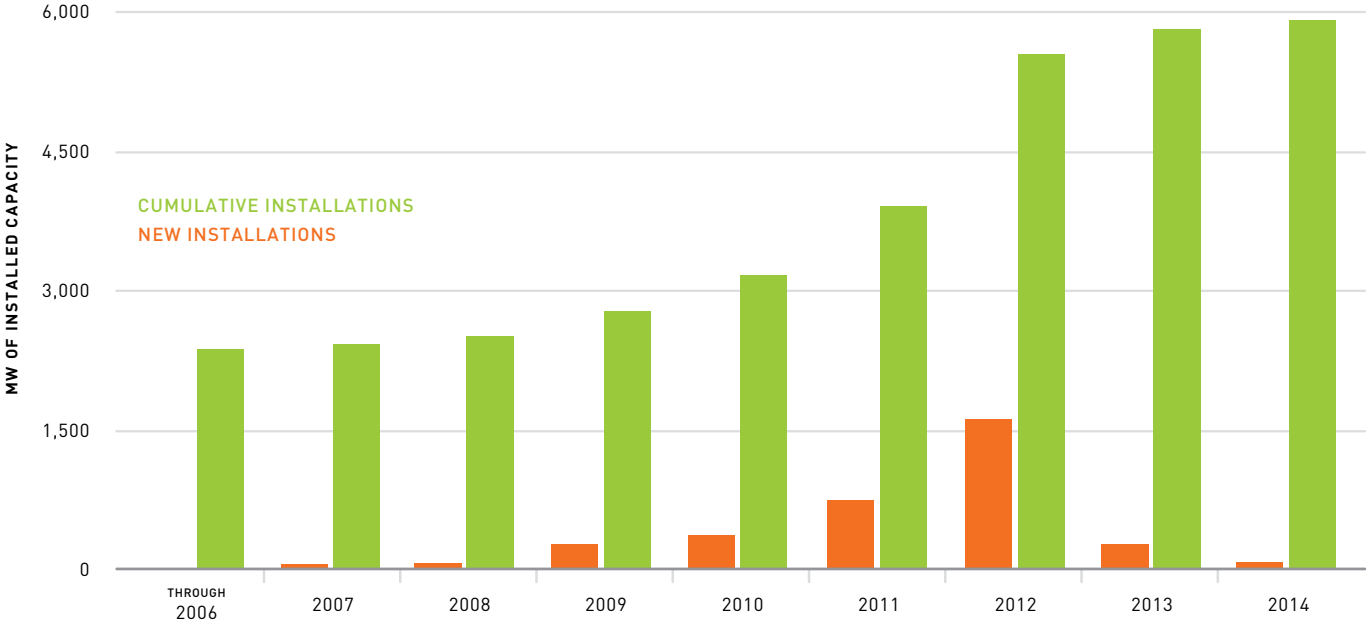
Cumulative wind energy installations continued to steadily increase, reaching nearly 6,000 MW of installed capacity in 2014 (Figure 37). However, new capacity declined significantly since 2012 (-95%) following uncertainty around federal tax incentives for wind, and the state installed only 87 MW of new capacity in 2014.

FIGURE 36. NEW SOLAR ENERGY INSTALLATIONS
CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission - California Solar Initiative, and Solar Energy Industries Association and GTM Research. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 37. WIND ENERGY INSTALLATIONS
CALIFORNIA



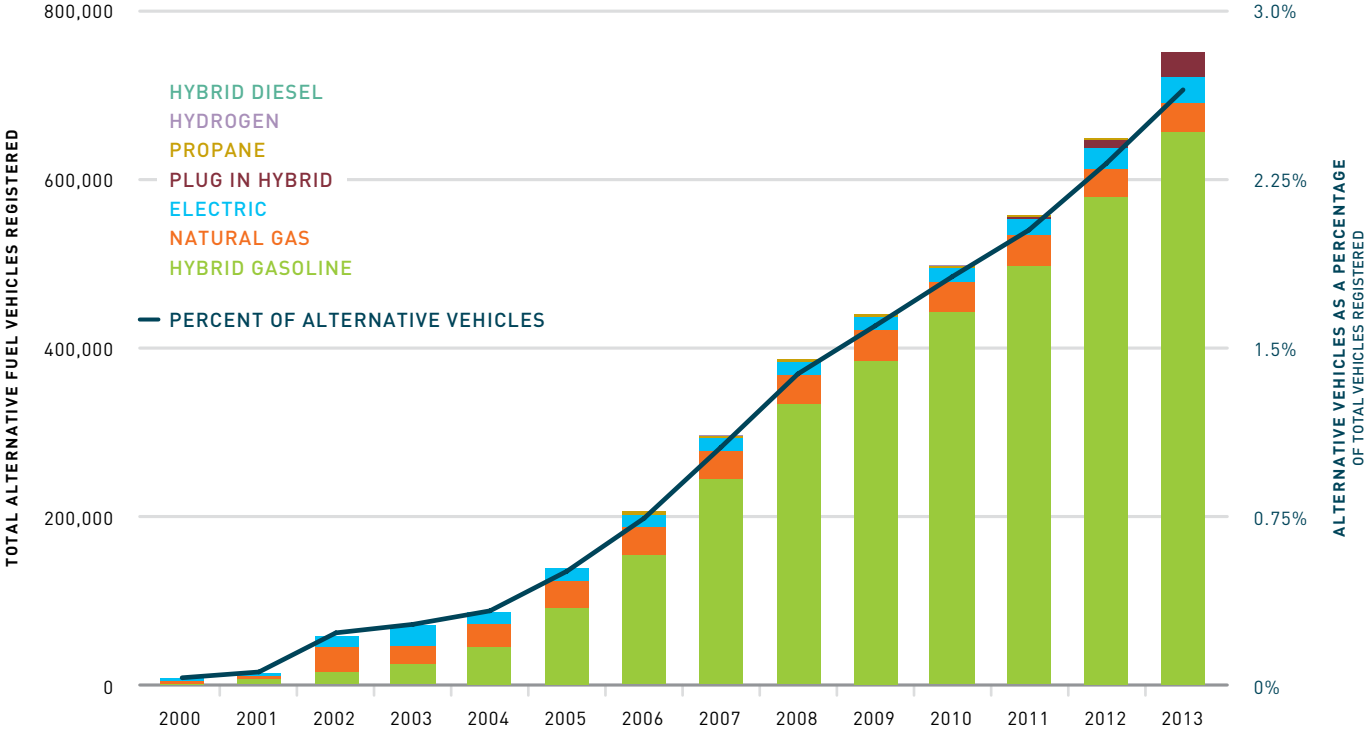
NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: American Wind Energy Association. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

TRANSPORTATION

California continues to increase alternative fuel vehicle registrations, with a 16 percent increase between 2012 and 2013, while overall vehicles increased only 1.5 percent (Figure 38). Zero emission vehicle registrations, including plug-in hybrid, electric, and hydrogen vehicles, jumped 75 percent over the same time period, reaching 60,000 in 2013.

FIGURE 38. TRENDS IN ALTERNATIVE FUEL VEHICLE REGISTRATIONS

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Energy Commission. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

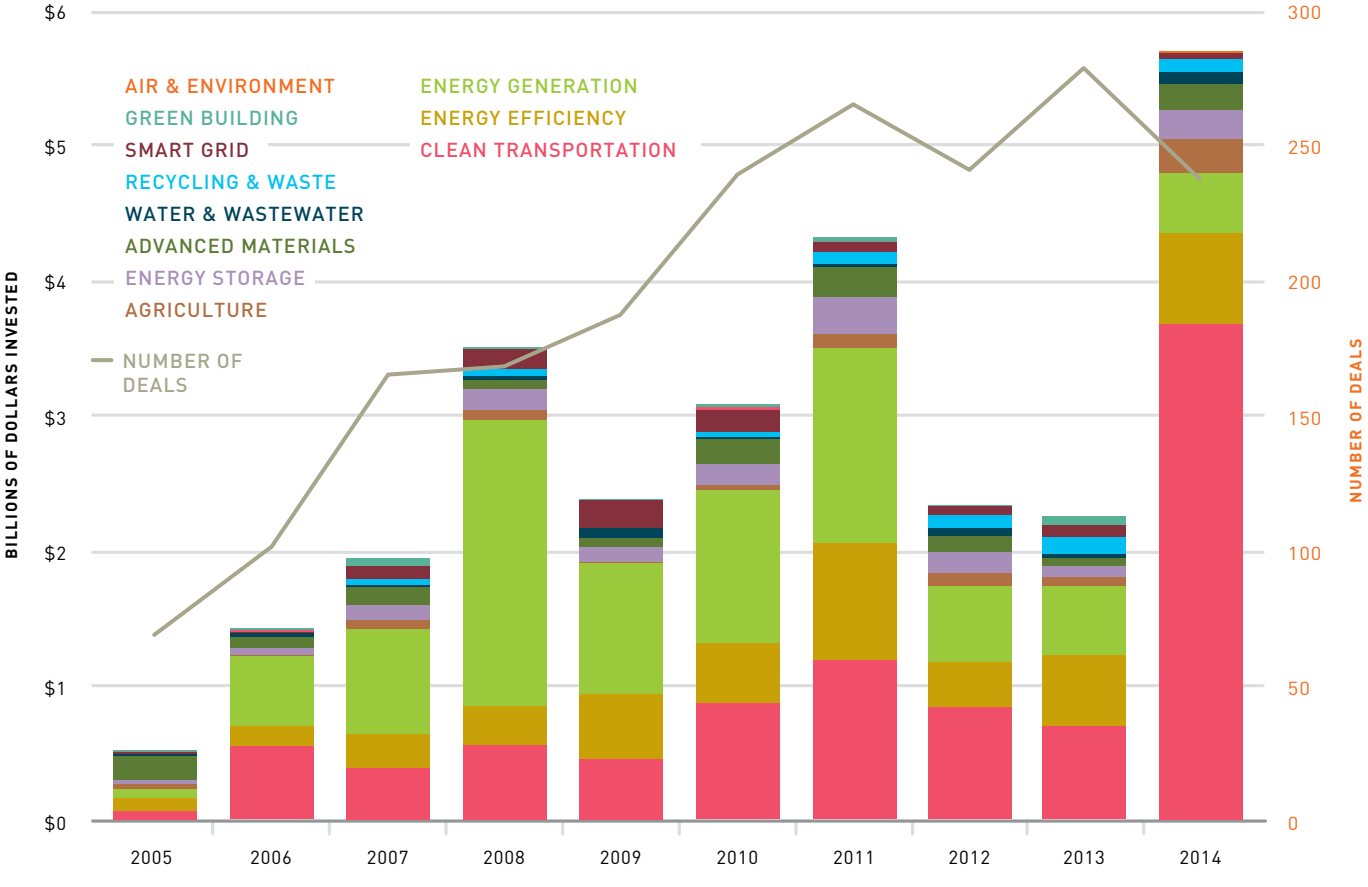
CLEAN TECHNOLOGY INNOVATION

Venture capital investment in California's clean technology companies surged to $5.7 billion in 2014, while the total number of deals declined (Figure 39). The vast majority of investments were in Clean Transportation companies, with $3 billion going to the car sharing company Uber. Taking out this investment in Uber, California venture capital still increased 20 percent compared to 2013.

Clean technology patent documents grew 26 percent between 2013 and 2014, driven by growth in Energy Storage patents (+47%) (Figure 40). Energy Efficiency was the largest segment in 2014 with 679 patents, 41 percent more than in 2013.

FIGURE 39. VENTURE CAPITAL INVESTMENT IN CLEAN TECHNOLOGY BY SEGMENT

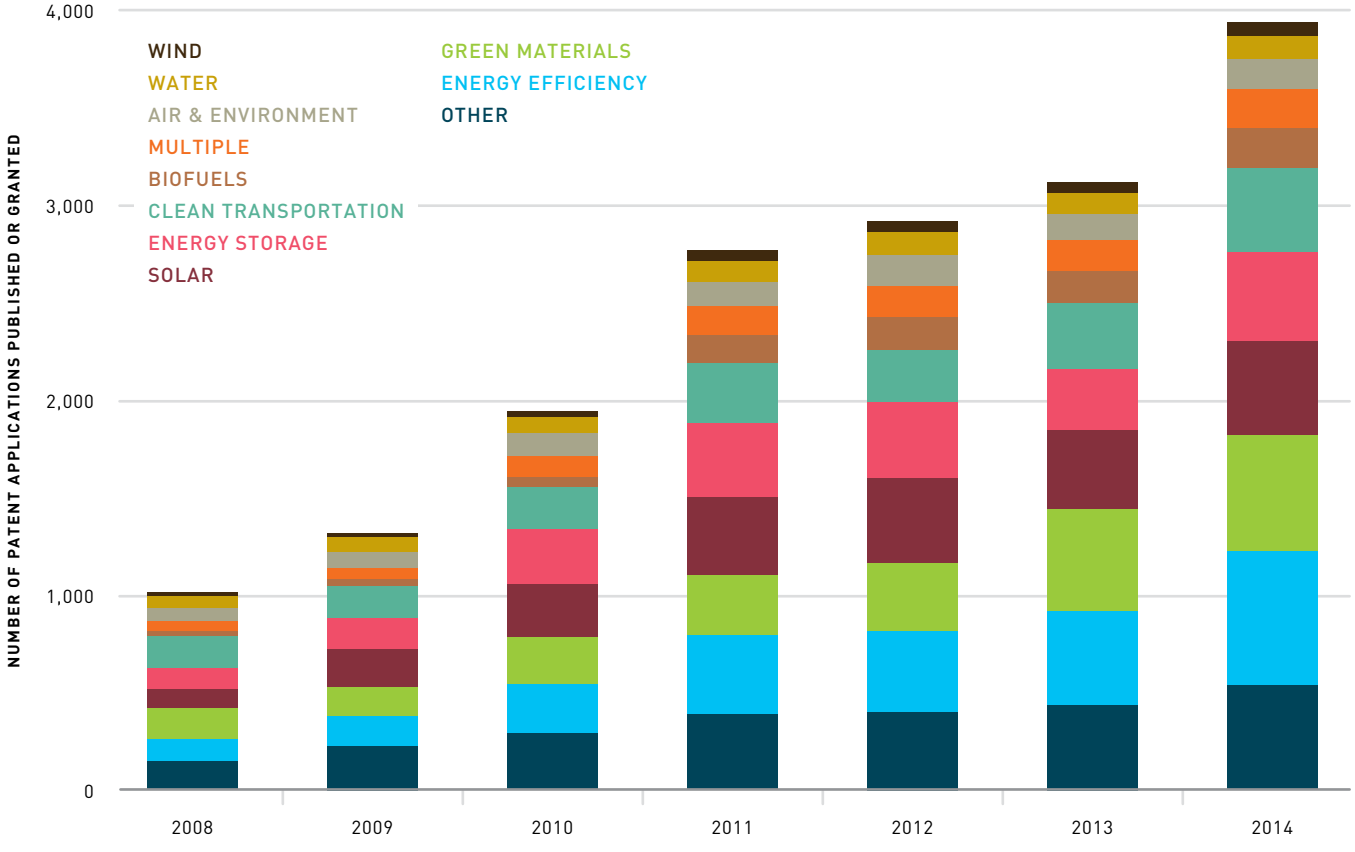
CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Amount unadjusted for inflation (nominal), the company Uber accounted for $3 billion of the California total in 2014. Data Source: Cleantech Group LLC. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 40. CLEAN TECHNOLOGY PATENTS BY TECHNOLOGY TYPE

CALIFORNIA, 2008–2014



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Number of patents measured by first patent application published or granted in patent family. Other includes Agriculture, Manufacturing/Industrial, Recycling & Waste, Geothermal, Other Renewable, and Renewable Water Power. Data Source: IP Checkups, CleanTech Patent Edge. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

REGIONAL INDICATORS SPOTLIGHT

SAN FRANCISCO BAY AREA

- The Bay Area has the most jobs in the state's clean economy, with nearly 59,000 jobs as of January 2014.
- Energy Generation is the largest segment in the region, with 16,500 jobs in areas such as solar installations. The region also has the most jobs in the state in Energy Infrastructure (9,100), such as smart grid-related jobs.
- The region had the most total California Solar Initiative installations, with 382 MW installed between 2007 and 2014.
- The Bay Area had the highest number of zero emission vehicles in the state with more than 18,000 registrations in 2013, a 90 percent increase compared to 2012.

SAN DIEGO REGION

- The San Diego Region had about 25,000 clean economy jobs as of January 2014, the third highest in the state.
- Most of the region's clean economy jobs were in Energy Generation (7,200) followed by Air & Environment (5,400).
- The region had 162 MW of solar installed through the California Solar Initiative in 2007–2014.
- The San Diego region had more than 6,000 zero emission vehicle registrations as of 2013, a 66 percent jump compared to 2012.

LOS ANGELES AREA

- The Los Angeles Area has the second highest number of clean economy jobs in the state, with nearly 39,000 as of January 2014.
- The region has the most jobs in the Air & Environment and Recycling & Waste segments in the state, with 9,100 and 7,500 jobs, respectively.
- The region had about 250 MW in solar installations through the California Solar Initiative between 2007 and 2014.
- The Los Angeles Area has the highest total number of natural gas vehicles.
- The region had the second highest number of zero emission vehicles at about 16,000 in 2013, up 91 percent compared to 2012.

INLAND EMPIRE

- The Inland Empire had nearly 13,000 clean economy jobs in January 2014. The largest segment in the region was Recycling & Waste, with 4,500 jobs.
- The region installed a total of 237 MW of solar through the California Solar Initiative, with 46 MW installed in 2014 alone.
- The Inland Empire had about 3,600 zero emission vehicle registrations in 2013, up 48 percent from 2012, and more than 4,000 natural gas vehicles in 2013.

ORANGE COUNTY

- Orange County had the fourth highest number of clean economy jobs in the state, with 16,500 jobs in January 2014. The largest segment in the region was Air & Environment (4,800 jobs).
- The region installed nearly 95 MW of solar through the California Solar Initiative between 2007 and 2014.
- Orange County had the largest increase (93%) in zero emission vehicles between 2012 and 2013, reaching nearly 7,400 total registrations.

SAN JOAQUIN VALLEY

- The San Joaquin Valley had 10,500 clean economy jobs in January 2014, and had the most Agriculture Support jobs in the state.
- The region had the most California Solar Initiative installations in 2014, with nearly 51 MW that year, and the second highest cumulative total, reaching 290 MW.
- San Joaquin Valley had 1,600 zero emission vehicle and 2,600 natural gas registrations in 2013.

SACRAMENTO AREA

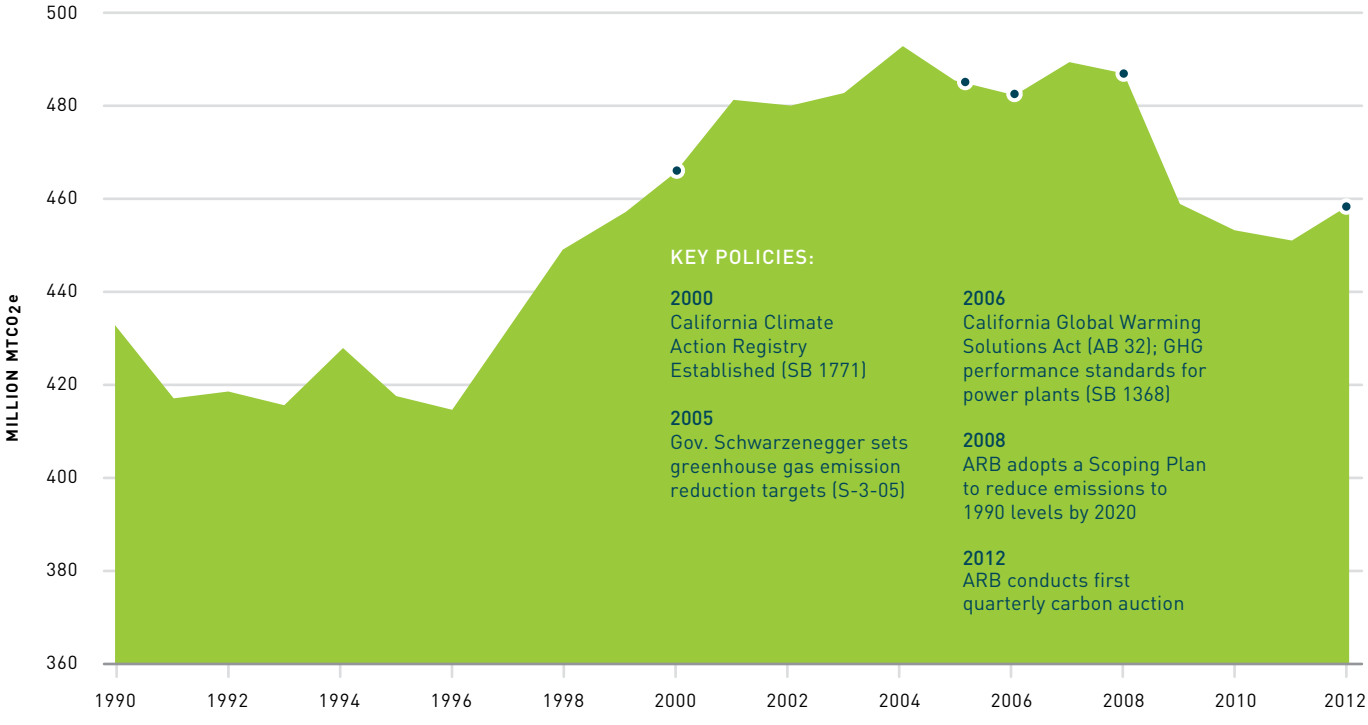
- The Sacramento Area had nearly 14,000 clean economy jobs in January 2014, a third of which were in the Air & Environment segment.
- The region had nearly 66 MW of solar installed through the California Solar Initiative between 2007 and 2014.
- The Sacramento Area had about 3,100 zero emission vehicle registrations in 2013, 37 percent more than in 2012, and about 2,200 natural gas vehicles.

CALIFORNIA'S INNOVATIVE POLICIES SUPPORT MARKET EXPANSION

California is a national and global leader in innovative environmental and energy policy, building off its decades of experience. The state's policies and programs have been replicated in other states and used as a model for federal legislation. The charts below overlay key California policies with progress in the related indicator. While many factors affect markets and energy trends, such as economic and population changes, this illustration shows the state's continued support for the market expansion of clean technologies. These policies are the product of combined efforts by public leaders, business leaders, grassroots organizations, and voters. Please see past editions of the California Green Innovation Index for a display of these policies in an illustrative policy timeline.

FIGURE 41. TOTAL CALIFORNIA GREENHOUSE GAS EMISSIONS

GROSS ANNUAL EMISSIONS



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: California GHG emissions that allow for country/regional comparison are from the U.S. Energy Information Administration and limited to carbon emissions from energy consumption, therefore these values differ from previous charts. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - by Sector and Activity. Analysis: Collaborative Economics.

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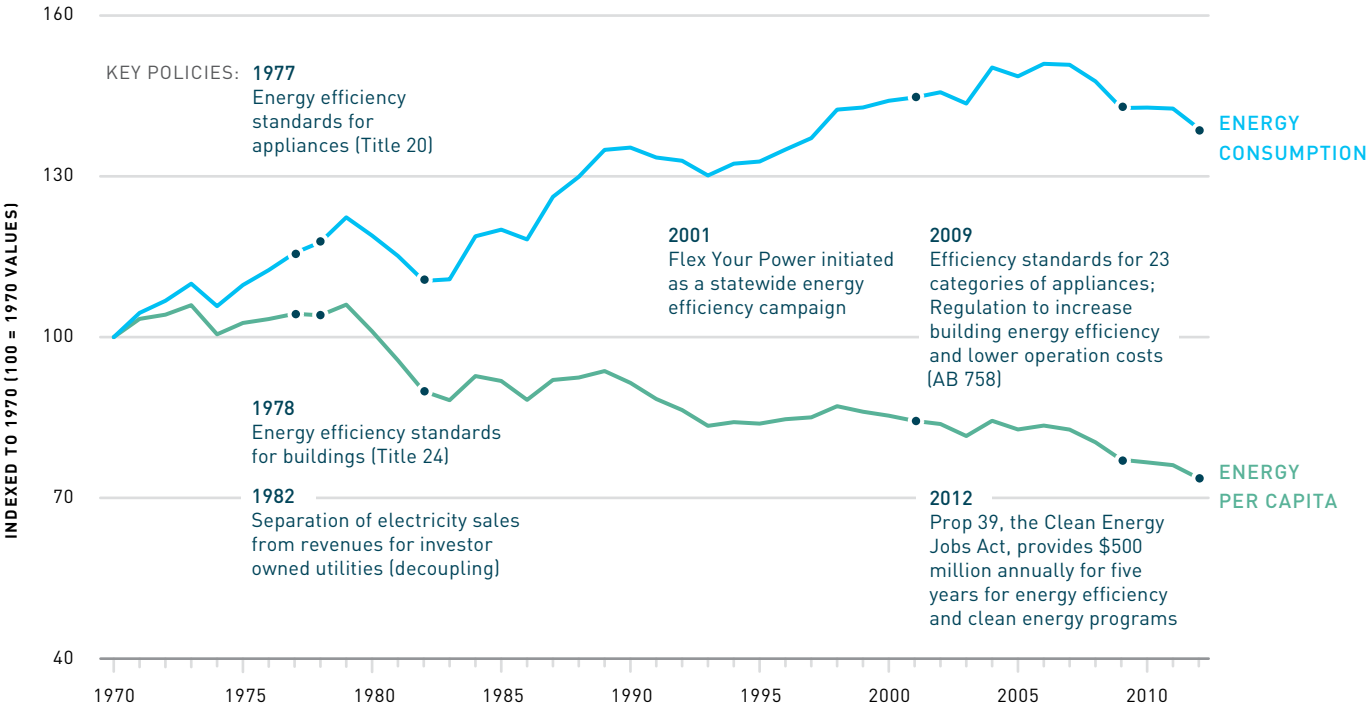
FIGURE 42. TOTAL ENERGY CONSUMPTION RELATIVE TO 1970

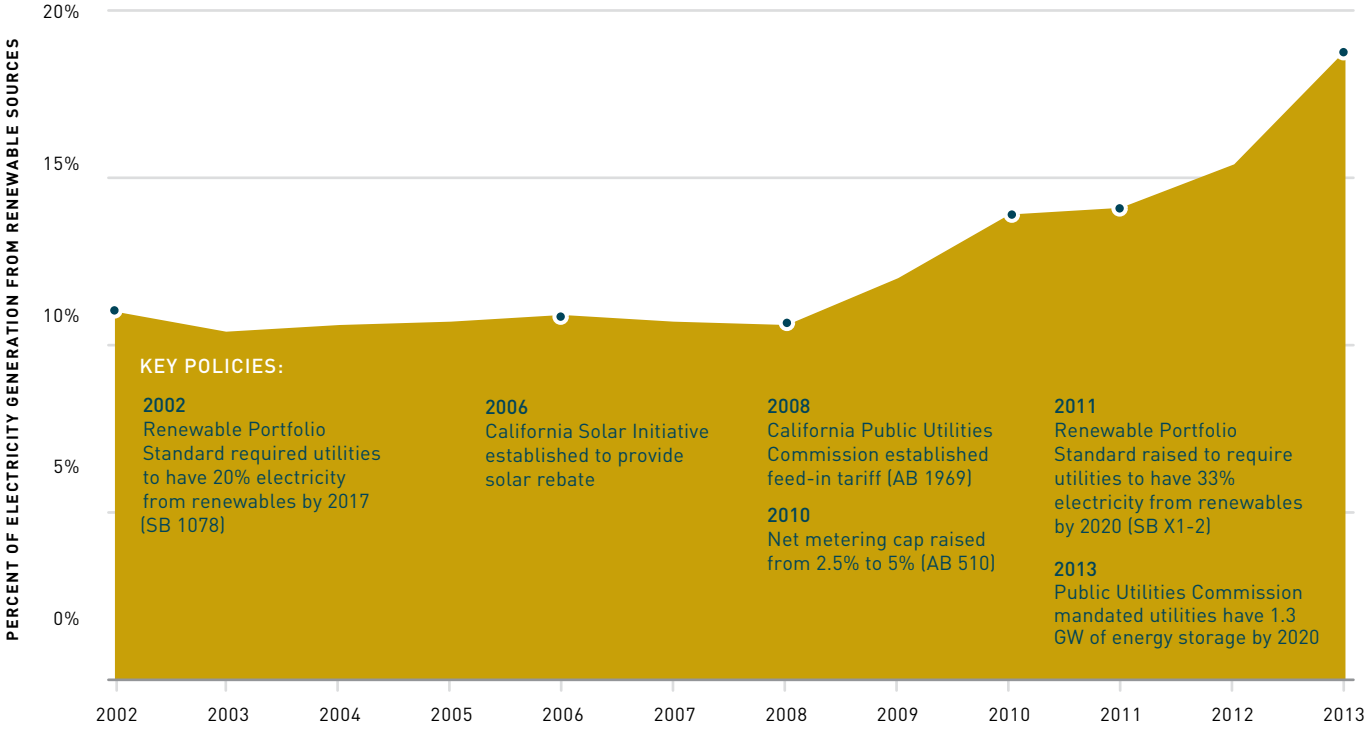
TOTAL CONSUMPTION AND PER CAPITA: CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: U.S. Energy Information Administration, State Energy Data System; U.S. Census Bureau, Population Estimates Branch. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 43. PERCENT OF TOTAL ELECTRICITY GENERATION FROM RENEWABLE SOURCES

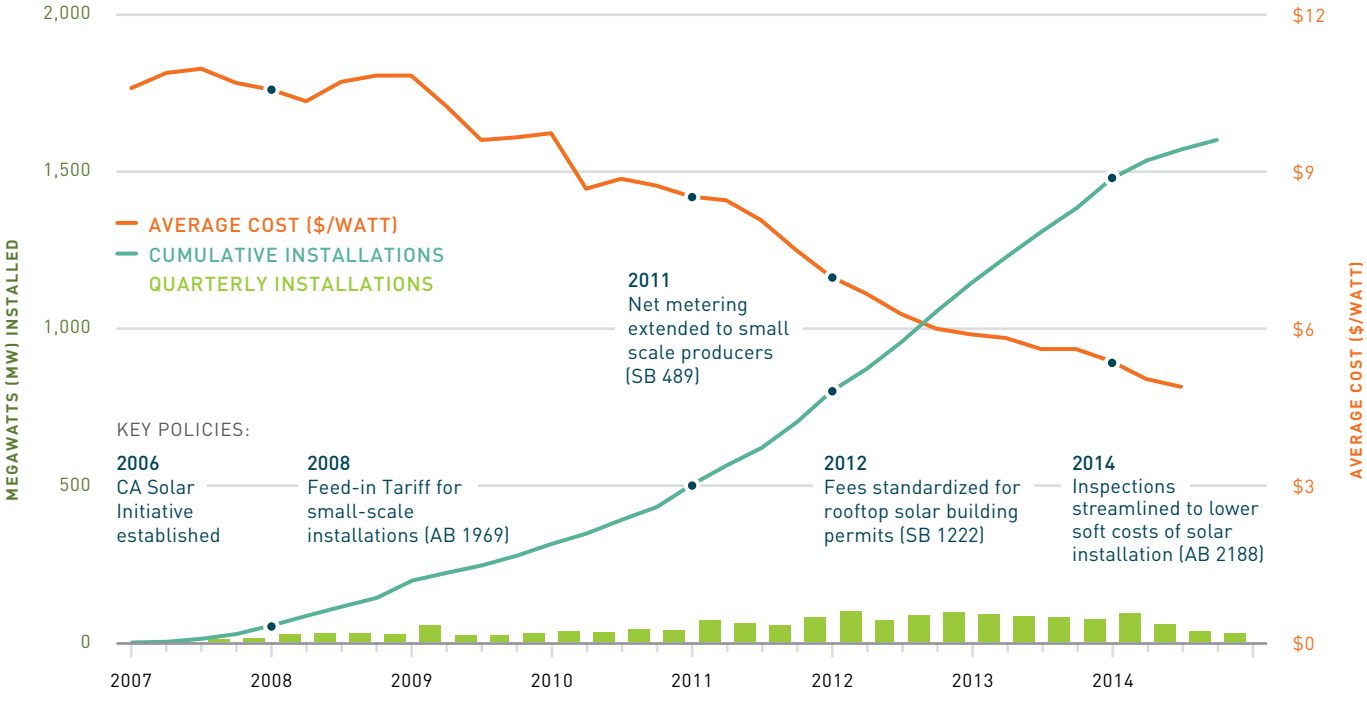
CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Renewables do not include large hydro. Data Source: California Energy Commission. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 44. SOLAR INSTALLATIONS

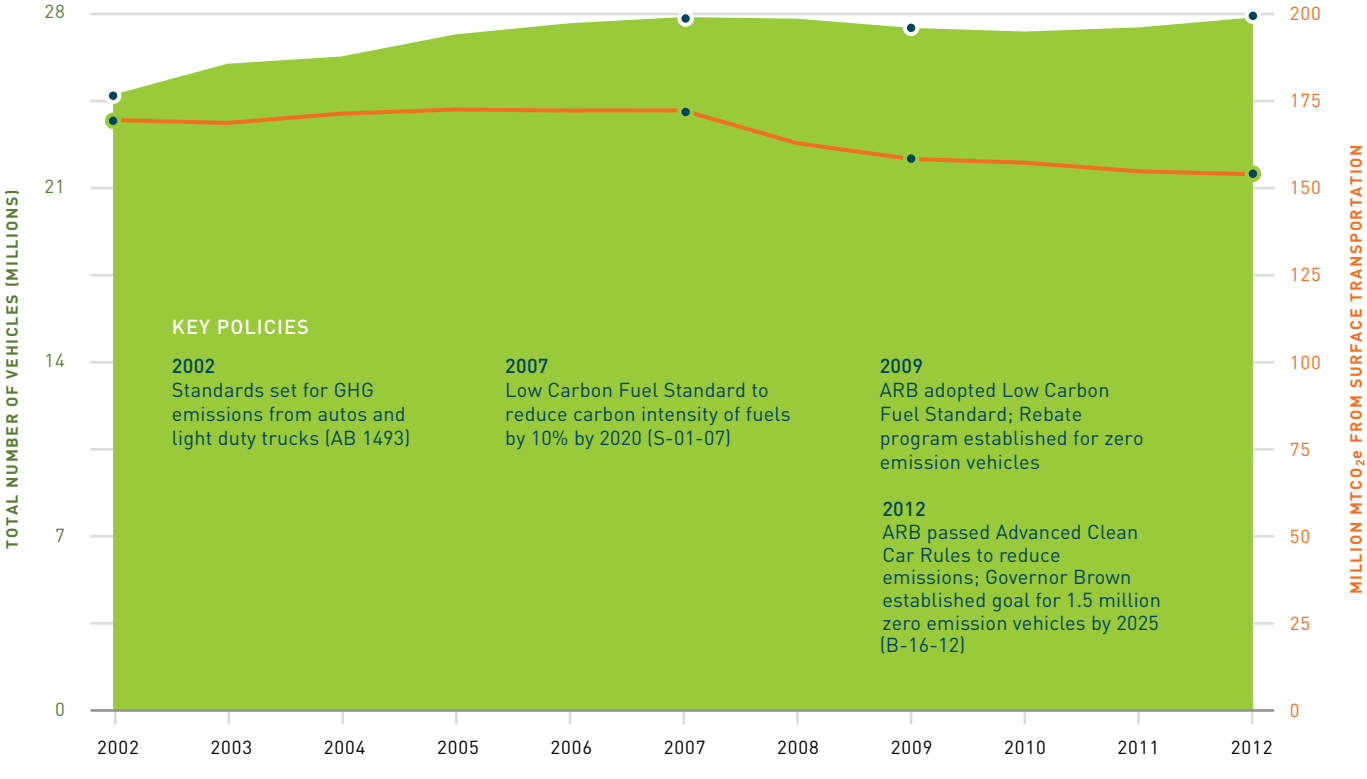
CAPACITY (MW) INSTALLED AND AVERAGE COST ($/WATT) THROUGH THE CALIFORNIA SOLAR INITIATIVE



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Data Source: California Public Utilities Commission - California Solar Initiative. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

FIGURE 45. TOTAL VEHICLES AND GREENHOUSE GAS EMISSIONS FROM TRANSPORTATION

CALIFORNIA



NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. Note: Total number of vehicles are for all vehicles registered in California including cars and trucks. Data Source: California Air Resources Board, California Greenhouse Gas Inventory - By Sector and Activity; California Energy Commission. Analysis: Collaborative Economics. NEXT 10 / SF · CA · USA

2014–2015 CALIFORNIA POLICY UPDATE

DATE	CATEGORY	POLICY & EVENTS
March 2014	ENERGY EFFICIENCY	California Energy Commission announces it will update energy efficiency standards for 15 appliances over the next two years
April 2014	AIR & ENVIRONMENT	California residential and small business customers start seeing a Climate Credit from utilities on their electricity bills, which can be used to help cut their energy use
May 2014	AIR & ENVIRONMENT	California Air Resources Board approves the first update to the 2008 Scoping Plan with key focus areas to reduce greenhouse gas emissions levels to the 1990 level by 2020
June 2014	RENEWABLE ENERGY	California extends the property tax exclusion for solar systems to 2025 (SB 871)
June 2014	RENEWABLE ENERGY	California extends the Self-Generation Incentive Program funding to 2019, which helps customers switch to clean energy and provides a bridge for clean energy technologies to scale up and drive down costs (SB 861)
September 2014	RENEWABLE ENERGY	California passes a law to streamline permitting and inspection for small solar systems to help lower soft costs of installing solar (AB 2188)
September 2014	CLEAN TRANSPORTATION	California lawmakers pass a bundle of bills to grow the electric vehicle market, including providing higher incentives for low-income individuals and improving access to charging stations for property renters
September 2014	CLEAN TRANSPORTATION	California passes law to accelerate the development and deployment of zero- and near-zero emissions trucks, buses, and freight vehicles and equipment (SB 1204)
September 2014	AIR & ENVIRONMENT	The California Infrastructure and Economic Development Bank (IBank) creates a Clean Energy Finance Center to encourage and leverage investments in clean energy and energy efficiency projects
November 2014	AIR & ENVIRONMENT	California holds its first joint carbon auction with the Canadian province of Quebec, creating the biggest carbon market in North America
January 2015	AIR & ENVIRONMENT	The California cap-and-trade program starts to cover fuel distributors, including distributors of heating and transportation fuels
April 2015	AIR & ENVIRONMENT	Governor Brown sets an executive order target to reduce GHG emissions 40 percent below 1990 levels by 2030

WHAT'S ON THE HORIZON IN 2015

DATE	CATEGORY	POLICY & EVENTS
January 2015	RENEWABLE ENERGY	Governor Brown proposed an expanded renewable energy goal of 50% by 2030 and other greenhouse gas emission reduction efforts
February 2015	AIR & ENVIRONMENT	California State Senators introduced a package of legislative proposals to accelerate the clean-energy economy. Proposed bills include reducing emissions 80% below 1990 levels by 2050, and by 2030 reducing petroleum use by 50%, increasing renewable energy to 50%, and increasing energy efficiency in buildings by 50%

NEXT 10 CALIFORNIA GREEN INNOVATION INDEX. NEXT 10 / SF · CA · USA

APPENDIX

GENERAL REFERENCES

Gross Domestic Product

Nominal gross domestic product (GDP) data for California are sourced from the Bureau of Economic Analysis, U.S. Department of Commerce. Real GDP figures are nominal GDP data converted into 2010 dollars using the U.S. deflator.

Country GDP is in real 2010 dollars, expressed per U.S. dollar. International data are from the U.S. Department of Agriculture's Economic Research Service, derived from the latest edition of the World Bank's World Development Indicators and is filled in using other data sources. Conversion to dollars is based on a fixed 2010 exchange rate. GDP in the inside cover is from the World Bank Development Indicators, data are in current U.S. dollars and in international dollars using purchasing power parity (PPP) rates. An international dollar has the same purchasing power over GDP as the U.S. dollar has in the United States. Data in current U.S. dollars are converted from domestic currencies using single year official exchange rates. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources.

Inflation And Cost of Living Adjustment

Inflation-adjusted figures are converted into 2014 dollars using the U.S. city average Consumer Price Index (CPI) of all urban consumers, published by the Bureau of Labor Statistics. Cost of Living data is from the Missouri Economic Research and Information Center, which derives the cost of living index for each state by averaging the indices of cities and metropolitan areas in that state that participated in the Council for Community and Economic Research's survey.

Population

California population data used to calculate per capita figures are from the California Department of Finance's "E-4 Population Estimates for Cities, Counties and the State, with 2000 and 2010 Census Counts."

Country population data are from the U.S. Department of Agriculture's Economic Research Service, calculated from the Census Bureau International Population Database.

European Union

The EU-28 countries include Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, and United Kingdom.

THE CARBON ECONOMY

Global Fossil Fuel Combustion, Carbon Economy, and Emissions Per Capita in California and Other Regions

Data for carbon dioxide emissions from the consumption of energy are from the U.S. Department of Energy – Energy Information Administration (EIA), International Energy Statistics. State level emissions data come from EIA's State CO_2 Emissions. Data for carbon dioxide emissions from the consumption of energy include emissions due to the consumption of petroleum, natural gas, and coal, and also from natural gas flaring. Energy consumption data are based on the consumption of each primary energy source, and data are gathered from a variety of national and organization reports that collate data from energy users. Carbon dioxide emissions are calculated for each individual fuel by applying carbon emission coefficients to convert to million $MTCO_2e$ emitted per quadrillion BTU of fuel consumed. Calculations used GDP and Population data where applicable, as described above.

Emissions data only include energy-related emissions, and therefore do not include emissions from sources such as agriculture, waste combustion, and industrial gases, because it is the most up-to-date information available. While these other emissions are important to track and reduce, the *Green Innovation Index* focuses on energy emissions, given the importance of energy-related indicators and the availability of recent data. A comparison of World Resources Institute's 2011 total world emissions data shows that energy-related emissions account for about 75 percent of global emissions. In addition, the ranking for the top emitters are similar when comparing total and energy-related emissions, and the rankings of the top six emitters are identical.

Cumulative Greenhouse Gas Emissions

Total cumulative GHG emissions data include historical GHG emissions for individual countries over the 1970–2010 period from the EDGAR data set, and supplemented with those from the MATCH emissions data set over the 1850–1970 period. Data were calculated by the PBL Netherlands Environmental

Assessment Agency, Ecofys and the European Commission's Joint Research Centre (JRC). Authors include Michel G. J. den Elzen; Jos G. J. Olivier; Niklas Höhne; and Greet Janssens-Maenhout. Data was published October 2013.

Total California, U.S., and EU Greenhouse Emissions by Sector

California total greenhouse gas (GHG) emissions data for emissions by sector and indicators in the California section of this report are from California Air Resources Board's "California Greenhouse Gas Inventory – by Sector and Activity" (April 2014). The 1990–1999 emissions include "gross emissions" and the 2000–2012 emissions are "included emissions" only. Calculations used GDP and Population data where applicable, as described above.

Comprehensive emissions data for U.S. and EU emissions by sector are from the U.S. Environmental Protection Agency's Inventory of U.S. GHG Emissions and Sinks: 1990–2012, inventory report 2014; and the European Environmental Agency's Annual European Union GHG Inventory 1990–2012, inventory report 2014.

Carbon Pricing Mechanisms

Data related to carbon pricing mechanisms primarily comes from the 2014 report "State & Trends Report Charts Global Growth of Carbon Pricing" by the World Bank Group and Ecofys. The report presents the status of each of these developing initiatives and explores the emerging trends of carbon pricing. The focus of the report is on the recent highlights from around the world, and on key lessons that can be drawn from the growing experience. Carbon pricing data was supplemented with more up-to-date information as needed.

ENERGY EFFICIENCY

Energy Productivity and Energy Consumption per Capita

Energy data are from the U.S. Department of Energy – EIA, International Energy Statistics and State Energy Data System. Data is for total primary energy consumption, in British Thermal Units (BTU), of petroleum, dry natural gas, coal, and net nuclear, hydroelectric, and non-hydroelectric renewable electricity. Energy productivity divides GDP by total energy consumption. Primary energy is in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy (for example, coal is used to generate electricity). Calculations used GDP and Population data where applicable, as described above.

Electricity Consumption per Capita

Electricity consumption data are from the U.S. Department of Energy, EIA, International Energy Statistics and State Energy Data System. For the United States, total electric power consumption is equal to the data in the Total column under End Use from Table 8.1 of the EIA's Annual Energy Review. For all other countries except the United States, total electric power consumption is equal to total net electricity generation, plus electricity imports, less electricity exports and less electricity transmission and distribution losses. Data are reported as net consumption as opposed to gross consumption. Net consumption excludes the energy consumed by the generating units. Calculations used Population data where applicable, as described above.

Coal Consumption per Capita and Production

Coal consumption and production data are from the U.S. Department of Energy, EIA, International Energy Statistics and State Energy Data System. Coal consumption includes anthracite, subanthracite, bituminous, subbituminous, lignite, brown coal, and for Estonia, oil shale. Consumption data also includes net imports of metallurgical coke. Calculations used Population data where applicable, as described above.

Statewide Electricity Bill as a Percent of GDP and Electricity Bill by Sector

Electricity pricing data are from the U.S. Department of Energy, EIA, Current and Historical Monthly Retail Sales, Revenues and Average Retail Price per Kilowatt-hour by State and by Sector (Form EIA-826), and includes the amount of electricity sold to end users (excludes self-generation). Electricity Bill Percent of GDP multiplies monthly retail sales and prices (by sector), aggregates by year and then divides by GDP. Data to calculate electricity bills by sector are from 1990–2013 use Retail Sales of Electricity by State by Sector Provider (EIA-861) and 1990–2013 Average Price by State by Provider (EIA-861), published by the U.S. Department of Energy, EIA. Electricity bill figures are inflation-adjusted.

RENEWABLE ENERGY

Renewable Electricity Generation

Data for total electricity generation and renewable electricity generation by source are from the U.S. Department of Energy – EIA, International Energy Statistics. Data are for both utility and nonutility sources, and are reported as net generation (as opposed to gross generation). Renewable electricity

data are for non-hydroelectric renewable, including geothermal, solar, tide, wave, wind, biomass and waste. Large hydro is not included because most U.S. Renewable Portfolio Standards do not include it in their renewables definition due to the technology's maturity (giving preference to newer technologies) and environmental concerns.

California renewable energy data is from the California Energy Commission, "Net System Power Reports" 2002–2012, Total System Power in Gigawatt Hours (GWh). U.S. data in the California section on total electricity generation data is from the U.S. Department of Energy, EIA, Electric Power Monthly reports. Annual totals from "Table 1.1 Net Generation by Energy Source: Total (All Sectors)," and "Table 1.1.A. Net Generation by Other Renewables: Total (All Sectors)." Because of different renewable energy definitions between California and the U.S., data represented for the U.S. do not include any hydro.

Solar Installations

Country-level solar installation data is from the International Energy Agency, Photovoltaic Power Systems Programme's report "Trends 2014 in Photovoltaic Applications: Survey Report of Selected IEA Countries between 1992 and 2013."

California solar capacity installed data are provided by Solar Energy Industries Association® (SEIA) and GTM Research and the California Solar Initiative. SEIA data were taken from the U.S. Solar Market Insight Reports, 2007–2014, and includes California Solar Initiative (CSI), municipal utility, and other utility-scale installations. CSI data for this indicator include all completed projects (across all sectors) from January 2007 through December 31, 2014, and the year is based on First Incentive Claim Request Review Date.

Wind Installations

Country-level wind installation data is from the Global Wind Energy Council, Global Wind Statistics 2014. California wind capacity installed and cumulative data are provided by the American Wind Energy Association. Data is taken from quarterly and annual U.S. Wind Industry Market Reports, 2006–2014.

Renewable Energy Project Financing

Project financing investment data are provided by Bloomberg New Energy Finance (www.bnef.com). Data are nominal (not adjusted for inflation). The Bloomberg New Energy Finance asset finance database tracked deals financing acquisition, new build, and refinancing for utility-scale renewable energy projects. Financing is primarily from private sector entities and includes tax equity, corporate financing, and loans from banks. In the Bloomberg database, estimates have been made for those deals with undisclosed values as well as for untracked deals aiming to close the gaps in coverage caused by time lags in deal discovery. Where portfolios have been financed across multiple states, equal proportions of the financing have been assigned to each state. The project finance data does not include other types of financing for implementation such as direct purchases by customers, property assessed clean energy (PACE) financing, energy service contracts, or revolving loans.

CLEAN TECHNOLOGY INNOVATION

Investment, M&As, and IPOs in Clean Technology

Clean technology investment data are provided by Cleantech Group's i3 database and includes disclosed investment deals in private companies. Data is through December 2014.

VC data includes Seed, Series A–E+, and Growth Equity series types. Debt includes loan guarantees from the federal government, as well as structured debt and loans from private investors such as banks, investment funds, and financial services groups. Totals may not be the same across charts because of different investment types included. Dollar amounts are unadjusted for inflation (nominal).

M&As are by location of the targeted company (e.g. not the buyer) in the year the deal was announced. IPOs are by location of the company and in the year the IPO was listed.

Clean Technology Patents

Global Clean Technology Patents are sourced from IP Checkups through the CleanTech Patent Edge™ database, which includes clean technology patent data including both granted patents and published patent applications from the U.S. Patent and Trade Office (USPTO) and the European Patent Office (EPO), and published patent applications from the World Intellectual Property Organization (WIPO, which includes 188 member countries). Patent counts by country included in this analysis reflect the location of the first named inventor in the earliest published patent within a patent family, as defined in INPADOC (International Patent Documentation). Inventors frequently file on the same invention in multiple patent systems (such as USPTO and also EPO), and analysis at the patent family level (i.e. the set of related patents for an invention, across systems) rather than at the individual patent level reduces double-counting of the same intellectual property. If country of first inventor was

unclear and could not be interpolated from other documentation, the patent family was excluded from the analysis.

IP Checkups classifies patents into clean technology segments based on patent classification codes and key word searches. Some patents fell into multiple segment and sub definitions, and if these segments were equally applicable — as defined by IP Checkups and Collaborative Economics — a patent was termed "multiple." Ranking analyses by segment includes any patent families classified into that segment, including those within family members which also apply to other segments. In contrast, total clean technology analysis includes only the dominant segment category, or the "multiple" designation to reduce double-counting. Assignee companies reflect the assignee at time of patent publication.

TRANSPORTATION

Pump Price for Gasoline

Country-level pump price for gasoline data comes from the GlobalPetrolPrices.com. Prices have been converted from the local currency to U.S. dollars and amounts per liter have been converted to gallons (3.785 liters = 1 gallon). California gasoline prices are from the California Energy Commission, Energy Almanac, historical yearly average gasoline price per gallon.

Global Electric Vehicle Sales

Global electric vehicle sales data are from Mock, P., Yang, Z. (2014), "Driving electrification: A global comparison of fiscal policy for electric vehicles," The International Council on Clean Transportation. 2014 data is preliminary. California data are from California New Dealers Association's California Auto Outlook report, using new vehicle registration data from Polk. U.S. data is the amount from the global sales data minus the California data.

GHG Emissions from Surface Transportation and Total Vehicles

GHG emissions data are from the CARB's "California Greenhouse Gas Inventory – by Sector and Activity." Surface Transportation emissions sources include passenger vehicles, motorcycles and light and heavy duty trucks. Total vehicles use vehicle registration data described below.

Vehicle Registrations

Data are from the California Energy Commission, compiled using vehicle registration data by fuel type from the California Department of Motor Vehicles. Alternative fuel-types include all hybrid (gasoline and diesel), electric, plug-in hybrid, hydrogen, propane, and natural gas. Zero emission fuel-types include electric, plug-in hybrid, and hydrogen.

GREEN ESTABLISHMENT DATABASE

Collaborative Economics has developed an approach for identifying and tracking the growth of businesses with primary activities in the Core Clean Economy. This methodology was originally developed for work carried out on behalf of Next 10, a California-based nonprofit, and published in the *California Green Innovation Index* and *Many Shades of Green* (2008, 2009, 2010, 2012, 2013, 2014).

The accounting of green business establishments and jobs is based on standard industrial classification (SIC) codes and multiple sources (including Bloomberg New Energy Finance, CB Insights, and the Cleantech Group™ LLC) for the identification and classification of green businesses, and also leverages a sophisticated internet search process. The National Establishments Time-Series (NETS) database, based on Dun & Bradstreet business-unit data, was sourced to extract business information such as jobs. The jobs numbers reported in the database reflect all jobs at each business location. In the case of multi-establishment companies, only the green establishments are included.

The multilayered process involves both automated and manual verification steps of business establishments and their activities. In cases where the results were uncertain and the activities of a business establishment could not be verified (e.g. on a company's website), the establishment was dropped from the database. Therefore, the analysis offers a conservative tracking of jobs in the Core Clean Economy. The 2014 analysis uses preliminary NETS data for clean economy companies identified in the 2012 database, and therefore does not include new companies that emerged in 2013 and 2014.

For more research on clean economy jobs and how the energy efficiency and renewable energy industry can create direct and indirect jobs, please see:

Wei, M., Patadia, S. and Kammen, D. M. "Putting renewables and energy efficiency to work: How many jobs can the clean energy industry generate in the U.S.?" 2010. Energy Policy, 38, 919–931.

Ferroukhi, Rabia, et. al. "Renewable Energy and Jobs." 2013. International Renewable Energy Agency (IRENA)

ENDNOTES

1 IPCC. "Summary for policymakers. Climate Change 2014: Impacts, Adaptation, and Vulnerability." Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. 2014. [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1–32. http://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf

2 OECD. "Green growth: Environmental Policies and Productivity can Work Together." Policy Brief. Secretary-General of the OECD. December 2014. http://www.oecd.org/greengrowth/PB-Green-Growth-EnvProductivity-Dec-2014.pdf

3 Lang, Matthias and Annette Lang. "Government of Baden-Württemberg Adopts Climate Protection Act." German Energy Blog. May 8, 2013. http://www.germanenergyblog.de/?p=13039

4 Ontario. "Joint Statement on Climate Change." State of California, Ontario, Quebec, and British Columbia. December 2014. http://www.ontario.ca/document/joint-statement-climate-change

5 California Climate Change Portal. "Intergovernmental Working Group of the Climate Action Team." State of California. Accessed March 2015. http://climatechange.ca.gov/climate_action_team/intergovernmental.html

6 IPCC. "Climate change threatens irreversible and dangerous impacts, but options exist to limit its effects." UN and Climate Change. November 2, 2014. http://www.un.org/climatechange/blog/2014/11/climate-change-threatens-irreversible-dangerous-impacts-options-exist-limit-effects/

7 See endnote 1.

8 See endnote 1.

9 U.S. Global Change Research Program. "Impacts on Society." Information from the 2014 National Climate Assessment. http://www.globalchange.gov/climate-change/impacts-society

10 Cal-Adapt, a product of the Public Interest Energy Research Program. 2015. http://cal-adapt.org/tools

11 UNEP. "Emissions Gap Report 2014." United Nations Environment Programme. November 2014. http://www.unep.org/publications/ebooks/emissionsgapreport2014/

12 The carbon economy indicators use only carbon dioxide emissions from the consumption of energy because that is the most up-to-date comprehensive information available. This data covers the majority of emissions, but does not factor in emissions from sources such as waste or land use change. A comparison of complete GHG emissions from 2011 showed similar rankings and the same rankings of the top six regions.

13 World Bank. "State & Trends of Carbon Pricing 2014." The World Bank Group and Ecofys, Washington, D.C. May 2014. http://www.worldbank.org/en/news/feature/2014/05/28/state-trends-report-tracks-global-growth-carbon-pricing

14 Bloomberg News. "China Plans National Carbon Market by 2016 Amid Emission Pledge." BloombergBusiness. November 24, 2014. http://www.bloomberg.com/news/2014-11-25/china-plans-national-carbon-market-by-2016-amid-emission-pledge.html

15 Doan, Lynn. "California-Quebec Carbon Auction Sells Out at $12.10." BloombergBusiness. December 3, 2014. http://www.bloomberg.com/news/2014-12-03/first-california-quebec-carbon-auction-sells-out-at-12-10-each.html

16 Nordhaus, William. "Estimates of the Social Cost of Carbon: Background and Results from the RICE-2011 Model." Cowles Foundation for Research in Economics, Yale University. October 2011. http://www.econ.yale.edu/~nordhaus/homepage/documents/CFDP1826.pdf

17 Carbon Disclosure Project. "Use of internal carbon price by companies as incentive and strategic planning tool." CDP North America. December 2013. https://www.cdp.net/CDPResults/companies-carbon-pricing-2013.pdf

18 World Bank. "73 Countries and Over 1,000 Businesses Speak Out in Support of a Price on Carbon." World Bank Group. September 22, 2014. http://www.worldbank.org/en/news/feature/2014/09/22/governments-businesses-support-carbon-pricing

19 See endnote 13.

20 The Economist. "ETS, RIP?" The Economist. April 20, 2013. http://www.economist.com/news/finance-and-economics/21576388-failure-reform-europes-carbon-market-will-reverberate-round-world-ets

21 European Commission. "Structural Reform of the European Carbon Market." European Commission, Climate Action. Accessed February 2015. http://ec.europa.eu/clima/policies/ets/reform/index_en.htm

22 BBC. "Australia votes to repeal carbon tax." BBC News. July 17, 2014. http://www.bbc.com/news/world-asia-28339663

23 See endnote 15.

24 RGGI. "CO_2 Auctions, Trading, & Offsets: Auction 26." Regional Greenhouse Gas Initiative. December 2014. https://www.rggi.org/market/co2_auctions/results/auction-26

25 Carroll, Rory. "California Revenue Hits $1.6 Billion." Reuters. March 17, 2015. http://www.reuters.com/article/2015/03/17/california-carbon-revenue-idUSL2N0WJ2JY20150317

26 Eberhard, Kristin. "All the World's Carbon Pricing Systems in One Animated Map." Sightline Daily. November 17, 2014. http://daily.sightline.org/2014/11/17/all-the-worlds-carbon-pricing-systems-in-one-animated-map/

27 Marcacci, Silvio. "Grid Parity, Low LCOE Driving 34% Global Renewables Capacity by 2030." CleanTechnica. October 18, 2013. http://cleantechnica.com/2013/10/18/grid-parity-low-lcoe-driving-34-global-renewables-capacity-2030/

28 Randall, Tom. "While You Were Getting Worked Up Over Oil Prices, This Just Happened to Solar." BloombergBusiness. October 29, 2014. http://www.bloomberg.com/news/articles/2014-10-29/while-you-were-getting-worked-up-over-oil-prices-this-just-happened-to-solar

29 Calica, Aurea. "Noy wants more investments in renewable energy". The Philippine Star. October 1, 2014 . http://www.philstar.com/headlines/2014/10/01/1375130/noy-wants-more-investments-renewable-energy

30 Goossens, Ehren. "Citigroup Sets $100 Billion Funding Goal for Green Projects." BloombergBusiness. February 18, 2015. http://www.bloomberg.com/news/articles/2015-02-18/citigroup-sets-100-billion-financing-goal-for-climate-projects

31 This patent analysis reflects counts of utility patent families globally in the INPADOC system, meaning counts of only the first patent application published or granted of an invention in a patent system, attributed to the location of the first named inventor on that application. This analysis excludes patents of the same invention in subsequent patent systems.

32 Climate Action Tracker. "Countries." Specific country sections referenced. Accessed January 2015. http://climateactiontracker.org/countries.html

[33] Office of the Press Secretary. "U.S.-China Joint Announcement on Climate Change." White House. November 12, 2014. http://www.whitehouse.gov/the-press-office/2014/11/11/us-china-joint-announcement-climate-change

[34] Lewis, Joanna. "Energy and Climate Goals of China's 12th Five-Year Plan." Center for Climate and Energy Solutions. March 2011. http://www.c2es.org/international/key-country-policies/china/energy-climate-goals-twelfth-five-year-plan

[35] See endnote 14.

[36] See endnote 14.

[37] See endnote 32.

[38] White House. "Climate Change and President Obama's Action Plan." The White House. Accessed February 2015. http://www.whitehouse.gov/climate-change

[39] C2ES. "Greenhouse Gas Emissions Targets." Center for Climate and Energy Solutions, U.S. Climate Policy Maps. Accessed February 2015. http://www.c2es.org/us-states-regions/policy-maps/emissions-targets

[40] North Carolina State University. "Summary Maps – RPS Policies and Energy Efficiency Resource Standards." Database of State Incentives for Renewables & Efficiency. Accessed February 2015. http://www.dsireusa.org/summarymaps/index.cfm?ee=1&RE=1

[41] European Commission. "The European Union Explained: Climate Action." European Commission. 2014. http://europa.eu/pol/pdf/flipbook/en/climate_action_en.pdf

[42] UNFCCC. "Time Series – Annex I, GHG Total excluding LULUCF." United Nations Framework Convention on Climate Change. Accessed February 2015. http://unfccc.int/ghg_data/ghg_data_unfccc/time_series_annex_i/items/3814.php

[43] European Commission. "2030 framework for climate and energy policies." European Commission, Climate Action. Accessed February 2015. http://ec.europa.eu/clima/policies/2030/index_en.htm

[44] European Commission. "The EU Emissions Trading System (EU ETS)." European Commission, Climate Action. Accessed February 2015. http://ec.europa.eu/clima/policies/ets/index_en.htm

[45] See endnote 32.

[46] EIA. "Countries, Analysis." U.S. Department of Energy, Energy Information Administration. Accessed February 2015. http://www.eia.gov/countries

[47] C2ES. "Summary: India's National Action Plan on Climate Change." Center for Climate and Energy Solutions. June 2008. http://www.c2es.org/international/key-country-policies/india/climate-plan-summary

[48] Moarif, Sara and Namrata Patodia Rastogi. "Market-Based Climate Mitigation Policies in Emerging Economies." Center for Climate and Energy Solutions. December 2012. http://www.c2es.org/docUploads/market-based-climate-mitigation-policies-emerging-economies.pdf

[49] Bloomberg News. "Modi Commits to Clean Environment by Doubling India's Coal Tax." Bloomberg News. February 28, 2015. https://www.bnef.com/core/news/97103

[50] Krishan, Barani. "Oil surges 8 percent as U.S. rig count plunges, shorts cover." PowerSource, Pittsburgh Post-Gazette. January 30, 2015. http://powersource.post-gazette.com/powersource/home-powersource/2015/01/30/UPDATE-8-Oil-surges-8-pct-as-U-S-rig-count-plunges-shorts-cover/stories/201501300232

[51] See endnote 32.

[52] See endnote 46.

[53] See endnote 32.

[54] IFC. "Russia's New Capacity-based Renewable Energy Support Scheme: An Analysis of Decree No. 449." International Finance Corporation, World Bank Group. 2013. http://www.ifc.org/wps/wcm/connect/f818b00042a762138b17af0dc33b630b/Energy-Suppor-Scheme-Eng.pdf?MOD=AJPERES

[55] See endnote 32.

[56] See endnote 32.

[57] See endnote 46.

[58] See endnote 32.

[59] See the Renewable Energy section analysis.

[60] See endnote 13.

[61] See endnote 46.

[62] OECD/IEA. "Germany Executive Summary and Key Recommendations." International Energy Agency. 2013. http://www.iea.org/Textbase/npsum/germany2013SUM.pdf

[63] See endnote 46.

[64] Huggler, Justin. "Germany's flagship green energy policy 'in tatters'." The Telegraph. September 2, 2014. http://www.telegraph.co.uk/news/worldnews/europe/germany/11070145/Germanys-flagship-green-energy-policy-in-tatters.html

[65] Thomas, Andrea, William Boston, and Christopher Alessi. "Germany Moves to Speed Renewable Energy Goal." The Wall Street Journal. December 3, 2014. http://www.wsj.com/articles/germany-moves-to-speed-clean-energy-goal-1417632445

[66] Forbes. "Best Countries for Business: South Korea." Forbes. Accessed February 2015. http://www.forbes.com/places/south-korea/

[67] Mansell, Anthony, Amanda Maridney, and Peter Sopher. "South Korea – The World's Carbon Markets: A Case Study Guide to Emissions Trading." Environmental Defense Fund and the International Emissions Trading Association. March 2014. http://www.ieta.org/assets/EDFCaseStudyMarch2014/south%20korea%20ets%20case%20study%20march%202014.pdf

[68] See endnote 46.

[69] See endnote 67.

[70] See endnote 32.

[71] Cho, Meeyoung. "S.Korea increases emissions cap in proposed carbon trading scheme." Reuters. September 11, 2014. http://www.reuters.com/article/2014/09/11/carbon-southkorea-idUSL3N0RC2N720140911

[72] See endnote 13.

[73] See endnote 46.

[74] Reuters. "Iran plans carbon emissions trading market, official says." Reuters. February 16, 2014. http://www.reuters.com/article/2014/02/16/iran-carbon-market-idUSL6N0LL0AP20140216

[75] See endnote 13.

[76] See endnote 46.

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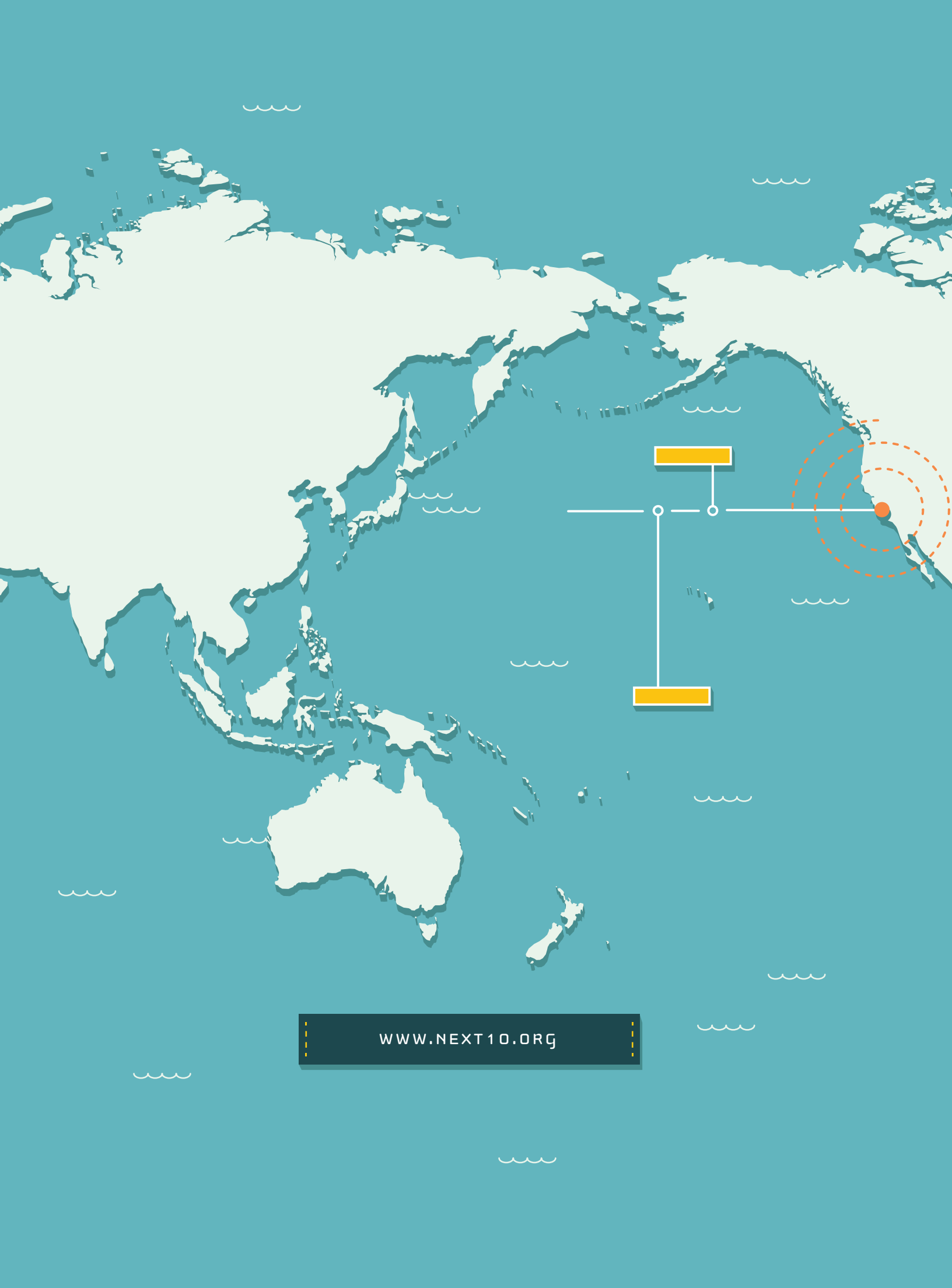
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