



Power Shifts

Emerging Clean Energy Markets

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For additional information on Pew's clean energy initiative, please visit pewtrusts.org/cleanenergy.

About the report

Power Shifts: Emerging Clean Energy Markets was developed for public informational and educational purposes. It is a complement to Pew's reports tracking 2009-13 clean energy investment in the countries that make up the Group of 20.

Underlying data for this report were compiled for Pew by Bloomberg New Energy Finance, a leading market research firm with a global network of analysts providing data and news on the transformation of the energy sector. Currency values are in U.S. dollars. A full description of the data sources and methodology employed in the development of this report can be found in the appendix on Page 20.

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The Pew Charitable Trusts is driven by the power of knowledge to solve today's most challenging problems. Pew applies a rigorous, analytical approach to improve public policy, inform the public, and invigorate civic life.

Overview

The world's energy dynamic is changing in response to powerful economic, security, and environmental forces. Investment in and deployment of electricity infrastructure is shifting from the industrialized economies of the Northern Hemisphere to the emerging economies of the "global south"—developing nations that tend to be disproportionally concentrated in the Southern Hemisphere—and from conventional fossil fuels toward advanced clean energy technologies.

The Pew Charitable Trusts' report series *Who's Winning the Clean Energy Race?* has tracked clean energy investment, finance, and deployment trends in the world's leading economies—those that comprise the Group of 20—since 2009.¹ During that span, a global recession, broad changes in energy markets, and uncertainty surrounding international policies on renewables and climate change have buffeted the industry. Despite these challenges, the clean energy sector is now a \$300 billion fixture of the world economy.

The overwhelming majority of worldwide clean energy investment occurs in the Group of 20—the world's largest economies, such as China, the United States, the European Union, Japan, India, and Brazil. Together, the G-20 accounted for more than 90 percent of global clean energy investment over the past decade.

At the same time, however, Pew's research has found that clean energy investment in developing countries has grown in real and relative terms. The scale and scope of renewable investment and deployment are expanding in these emerging economies in response to national economic development goals, local priorities for the environment and health, and international cooperation to reduce global energy poverty.

This report examines why and where clean energy is expanding in key markets of developing countries. It includes projections for investment and deployment of electric generating capacity through 2030 in both developed and developing markets. Finally, examining the five-year period from 2009 to 2013, this analysis identifies the top 10 emerging markets from among the 100 countries that are not members of either the G-20 or the Organization for Economic Cooperation and Development (OECD)²—the world's developed economies—and examines clean energy trends in developing nations. The key findings include:

Developing countries are likely to account for two-thirds of demand growth to 2030

Most of the future increase in energy demand will occur in the global south as developing nations seek to meet international goals to reduce energy poverty and keep pace with population growth. Because of this

3,700^{GW}

Expected OECD*
energy capacity
by 2030

* Organization for Economic
Cooperation and Development

7,000^{GW}

Expected non-
OECD energy
capacity by 2030

rising demand, developing nations will need to significantly increase their energy supplies. These countries are projected to account for more than two-thirds of all new global energy capacity over the next decade and a half. In total, non-OECD countries will add more than 4,100 gigawatts by 2030, resulting in about 7,000 GW—a nearly 150 percent increase over today's 2,800 GW.

150% Expected increase in new electricity capacity in non-OECD countries by 2030

Renewable energy will supply the majority of worldwide power capacity added through 2030

In view of its economic, security, and environmental advantages, clean energy is likely to play a major role in meeting the energy needs of developing countries. From 2013 to 2030, Bloomberg New Energy Finance projects, more than 5,570 GW of electricity capacity may be added globally. Renewable technologies are likely to supply 54 percent, or 3,000 GW, of total new capacity compared with less than 30 percent—1,584 GW—from fossil sources. Hydropower is on track to deliver 11 percent, and nuclear power is likely to fulfill 5 percent of the electricity generation added globally through 2030. In line with these trends, the data suggest that clean energy could attract more than two-thirds of the \$7.7 trillion worth of expected power investment over the same period.



Turbines in a fishing port in Taiwan.

Clean energy investment in emerging economies is small but growing

Strong investment flows have fueled the recent rise of clean energy deployment and associated price reductions across renewable energy sources. From 2009 to 2013, countries outside the G-20 attracted 6.6 percent, or \$75 billion, of the \$1.13 trillion in worldwide private investment in the clean energy sector. But the share of investment in these countries has increased rapidly in both real and relative terms. In 2011, clean energy investment in developing nations totaled \$13.8 billion, or 5.8 percent of the global total. By 2013, that figure had increased to \$16.7 billion, 8 percent of the global total. These emerging markets have helped offset some of the impact of reduced investment in developed economies, such as Germany and Spain.

10 nations lead the new emerging markets for clean energy

Reflecting the growing demand for energy and investment in advanced technologies, 100 countries outside the G-20 and the OECD attracted \$62 billion worth of clean energy investment from 2009 to 2013. Much of it occurred in a relatively small number of countries: Almost half (45 percent) of the total five-year investment, \$27.9 billion, occurred in 10 emerging markets. Nations in the top 10 span four continents, but half are located in East and Southeast Asia. Thailand is the leading market, attracting \$5.6 billion over the five-year period. Bulgaria and Ukraine account for almost \$8 billion, garnering \$4.6 billion and \$3.3 billion, respectively. Kenya is fourth with \$2.6 billion, and Peru is fifth with \$2.2 billion. Taiwan, Province of China; Morocco; Vietnam; Pakistan; and the Philippines round out the list.

Solar attracts the most investment in emerging markets

The solar industry led all renewable sectors, attracting \$12 billion, or 43 percent, of total clean energy investments in the top 10 markets from 2009 to 2013. Thailand and Bulgaria accounted for the most, with more than \$3 billion each for large-scale solar installations of more than 1 megawatt in size. The wind industry reaped the second-greatest sum at \$7.7 billion invested. Every country in the top 10 received wind project investments, led by Pakistan, Bulgaria, and Ukraine, which each attracted more than \$1 billion. Together, solar and wind represented more than 70 percent of all investment, accounting for 43 percent and 28 percent, respectively.

Other renewables also garnered significant investment. More than \$2.2 billion was invested in the biofuels and geothermal sectors. Kenya drew almost all of the geothermal investment, while Peru and Thailand each realized more than \$600 million for biofuels projects. Vietnam led in the small hydro category, bringing in \$1.2 billion of the nearly \$2.1 billion total invested in this sector.

Growth of clean energy capacity outpaced that of conventional technologies in the top 10 emerging markets from 2009 to 2013

Conventional fossil energy continues to represent the majority of installed energy capacity in the top 10, with 67 percent of the total. However, deployment of fossil fuel-powered plants grew by less than 10 percent from 2009 to 2013. Over the same period, clean energy capacity in the top 10 countries grew by 91 percent, three times faster than any other supply option.

Every one of the top 10 emerging market countries added wind, solar, biomass, geothermal, or small hydropower capacity from 2009 to 2013, and seven added large hydro installations. In contrast, only five added fossil fuel technologies, and just one built more nuclear power.

10/10

Ratio of emerging market countries that added wind, solar, biomass, geothermal, or small hydro from 2009 to 2013

Among renewables, installed solar power capacity grew the most across the top 10 emerging markets. Six countries placed an additional 3 GW of solar into service from 2009 to 2013, with Bulgaria (955 MW), Thailand (808 MW), and Ukraine (780 MW) accounting for the bulk of these gains. These same countries also accounted for much of the new wind turbine construction. Eight of the 10 countries installed wind energy (1.8 GW). Small hydropower capacity grew by 649 MW across seven countries, much of it in Vietnam. Thailand led the increase of 481 MW of biomass production, and Kenya accounted for nearly all of the additional geothermal plants.

Energy poverty is driving attention and resources to emerging economies

Efforts by countries outside the G-20 seeking to alleviate energy poverty, fuel economic progress, and protect the environment mean a promising long-term future for clean energy investment and deployment. According to the United Nations, more than 1.3 billion people are “energy poor,” lacking access to modern electricity services, with the overwhelming majority located in two regions, sub-Saharan Africa and Asia.



Solar powered house on Islas Flotantes, Peru.

Figure 1

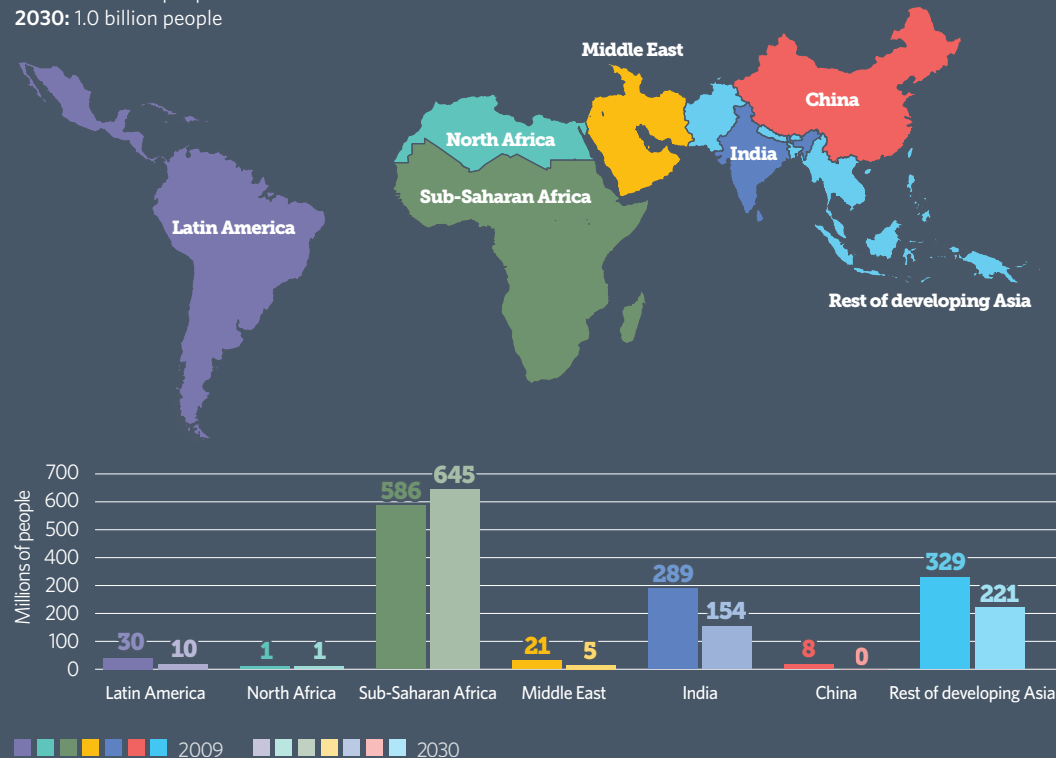
Current and Projected Populations Without Access to Electricity, by Region

Sub-Saharan Africa has largest

World population without access to electricity

2009: 1.3 billion people

2030: 1.0 billion people



Source: International Energy Agency

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The international community is making the elimination of energy poverty within the next 15 years a priority. According to U.N. Secretary-General Ban Ki-moon, “affordable and reliable modern energy services are essential for alleviating poverty, improving health, and raising living standards.” More than 100 nations have joined together under the auspices of the U.N.’s Sustainable Energy for All initiative, which has set three overarching goals to attain by 2030:

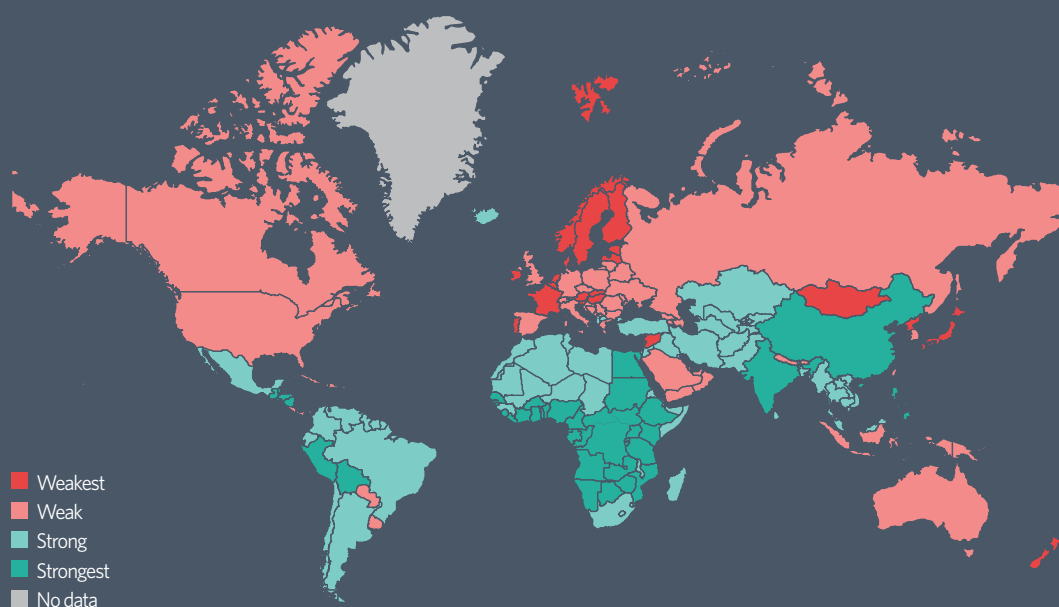
1. Achieve universal access to modern energy services.
2. Double the worldwide rate of energy efficiency improvement from 1.2 to 2.4 percent annually.
3. Double the share of renewable energy in the global energy mix from 15 to 30 percent.

Growth of future energy demand will be greatest in developing countries

Meeting international objectives for reducing energy poverty and keeping pace with development and demographic realities in the global south will mean that the vast majority of growth in energy demand will occur in developing countries. These nations will need significantly more energy to match expected population increases and to reach poverty reduction goals.

Figure 2

Anticipated Growth of Global Power Demand, 2012-30 Africa and Asia will see strongest increase



Source: Bloomberg New Energy Finance

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Research by Bloomberg New Energy Finance illustrates how much additional clean energy will be acquired by developed versus developing economies. For purposes of this report, new generating capacity is projected for developed countries that are members of the OECD³ and for developing countries that are not members of that organization.

Developing countries account for two-thirds of demand growth to 2030

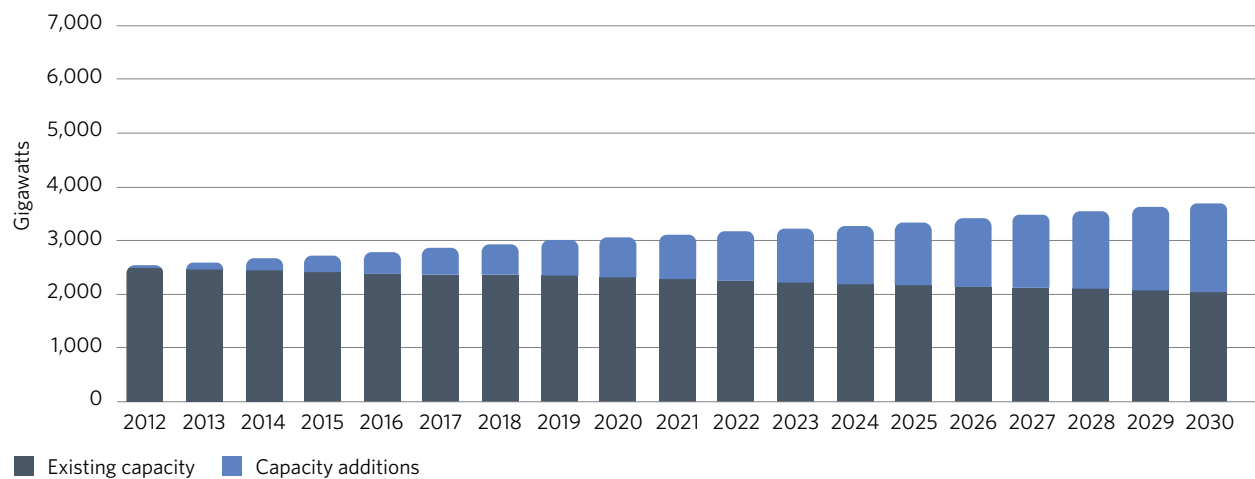
In many advanced economies, demand for electricity has flattened as populations have stabilized and energy efficiencies have been realized. Through 2030, OECD nations are on track to add or replace more than 1,600 GW of electric generating capacity for an installed total of slightly more than 3,700 GW, according to the Bloomberg New Energy Finance “2030 Market Outlook.”

The OECD is home to 2,500 GW of power production capacity, but deployment of power plants is likely to expand more rapidly in developing countries, which collectively are projected to account for more than two-thirds of the new capacity expected to be added globally over the next decade and a half. In total, non-OECD countries will add 4,100 GW by 2030, resulting in about 7,000 GW installed—a nearly 150 percent increase over today’s 2,800 GW.



A Masai tribesman looks at a geothermal power station in Hells Gate, Naivasha, Kenya.

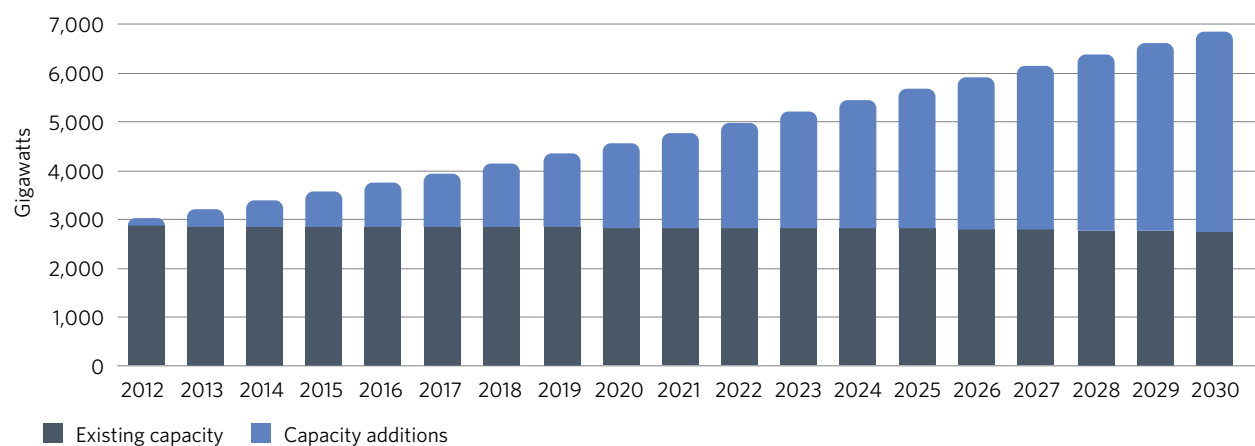
Figure 3
 OECD Capacity Additions, 2012-30
 Energy capacity will reach 3,700 GW



Source: Bloomberg New Energy Finance

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Figure 4
 Non-OECD Capacity Additions, 2012-30
 Anticipated growth of 4,100 GW by 2030, resulting in about 7,000 GW



Source: Bloomberg New Energy Finance

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Renewable energy projected to supply most new power capacity worldwide through 2030

In view of the economic, environmental, security, and infrastructure advantages that renewable energy offers for emerging economies, it is poised to provide the majority of new power generation over the next 15 years. Clean energy has a number of compelling attributes that make it increasingly attractive to both developed and developing countries as compared with conventional fossil fuel technologies:

- Solar and wind costs have declined for several decades, and once installed these technologies are not subject to the price volatility that has been associated with fossil fuel sources in recent decades.
- In many places with high electricity prices, clean energy is already cost-competitive with conventional sources and will become even more favorable in the future.
- Emerging markets can deploy solar, wind, and other renewable technologies without costly grid infrastructure, making it possible for developing countries to leapfrog the 20th-century model of energy service provision and employ the 21st-century solution of distributed service delivery, as they have done successfully in the telecommunications sector.
- Renewable energy technologies rely on domestically available resources rather than foreign suppliers and thus promote energy security.
- Clean energy sources do not produce local air pollution or global warming emissions that threaten human and planetary health.

In light of these factors, clean energy is projected to play a major role in meeting the energy needs of developing countries in the coming decades. From 2013 to 2030, more than 5,570 GW of electricity generation is forecast to be added around the world. Renewable technologies are projected to fulfill 60 percent, or 3,000 GW, of that total, compared with less than 30 percent—about 1,580 GW—from fossil energy sources. Hydropower and nuclear are projected to account for 10 percent and 5 percent, respectively, of the electricity generation added globally through 2030.

Worldwide, energy generation is set to become significantly more diverse; annual renewable additions are on track to more than double as a percentage of total installations over the next 15 years. Although clean energy sources accounted for 30 percent of annual capacity additions in

3,000^{GW}

Amount of new electricity capacity from renewable energy sources expected by 2030

10%

Amount of new electricity capacity from hydropower expected by 2030

2012, Bloomberg New Energy Finance estimates that figure could reach 65 percent by 2030. In contrast, annual fossil energy additions are likely to decline from 49 percent of the total in 2012 to only 18 percent in 2030.

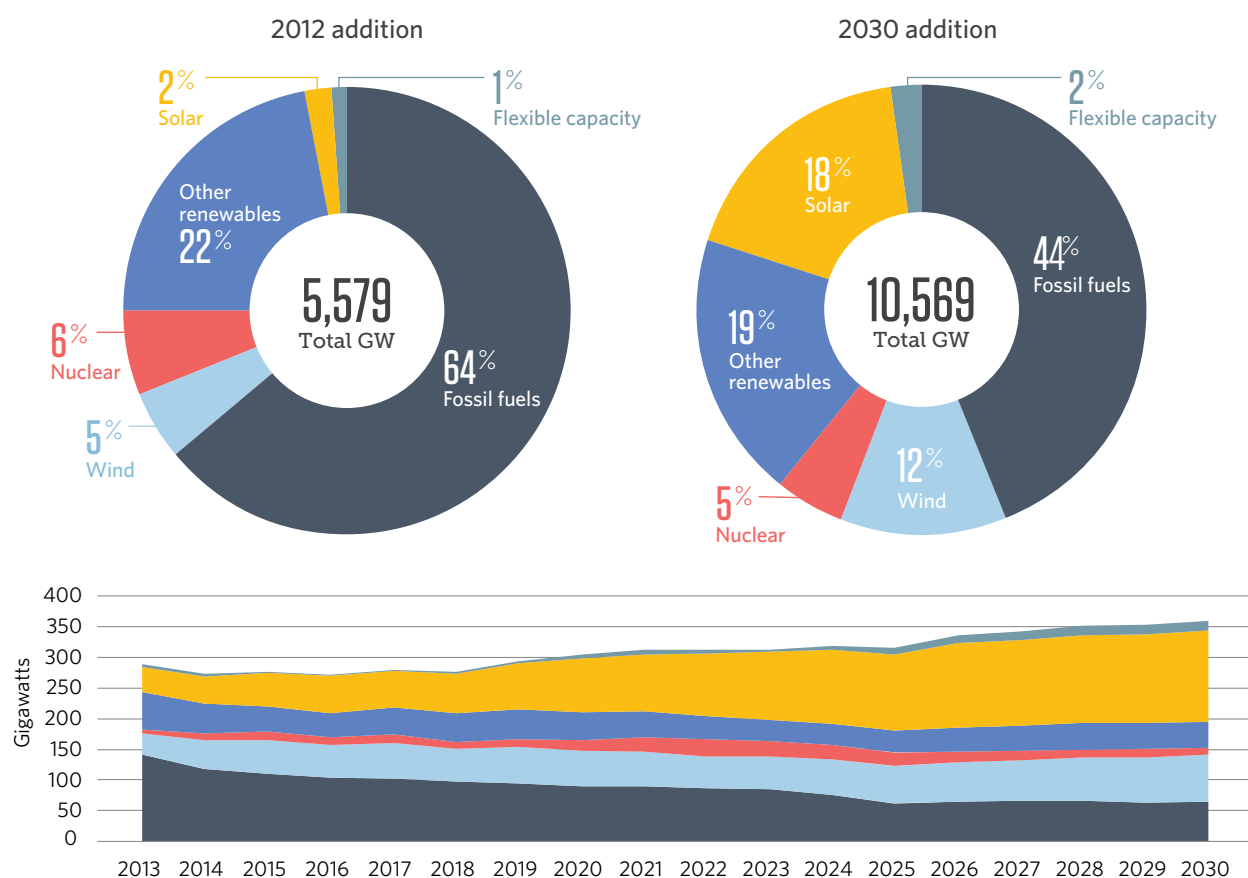
Projections indicate that renewable capacity is expected to exceed conventional sources between 2012 and 2030, with an expected 594 percent increase worldwide. By contrast, large hydropower capacity is projected to grow by 52 percent and nuclear by 69 percent, and fossil fuel-powered generation will experience the smallest growth, at just 30 percent over the same period, according to the Bloomberg New Energy Finance forecast.

594% Expected increase in installed renewable energy worldwide between 2012 and 2030

Figure 5

Global Annual Capacity Additions, 2013-30

Solar and other renewables will lead non-fossil-fuel installations

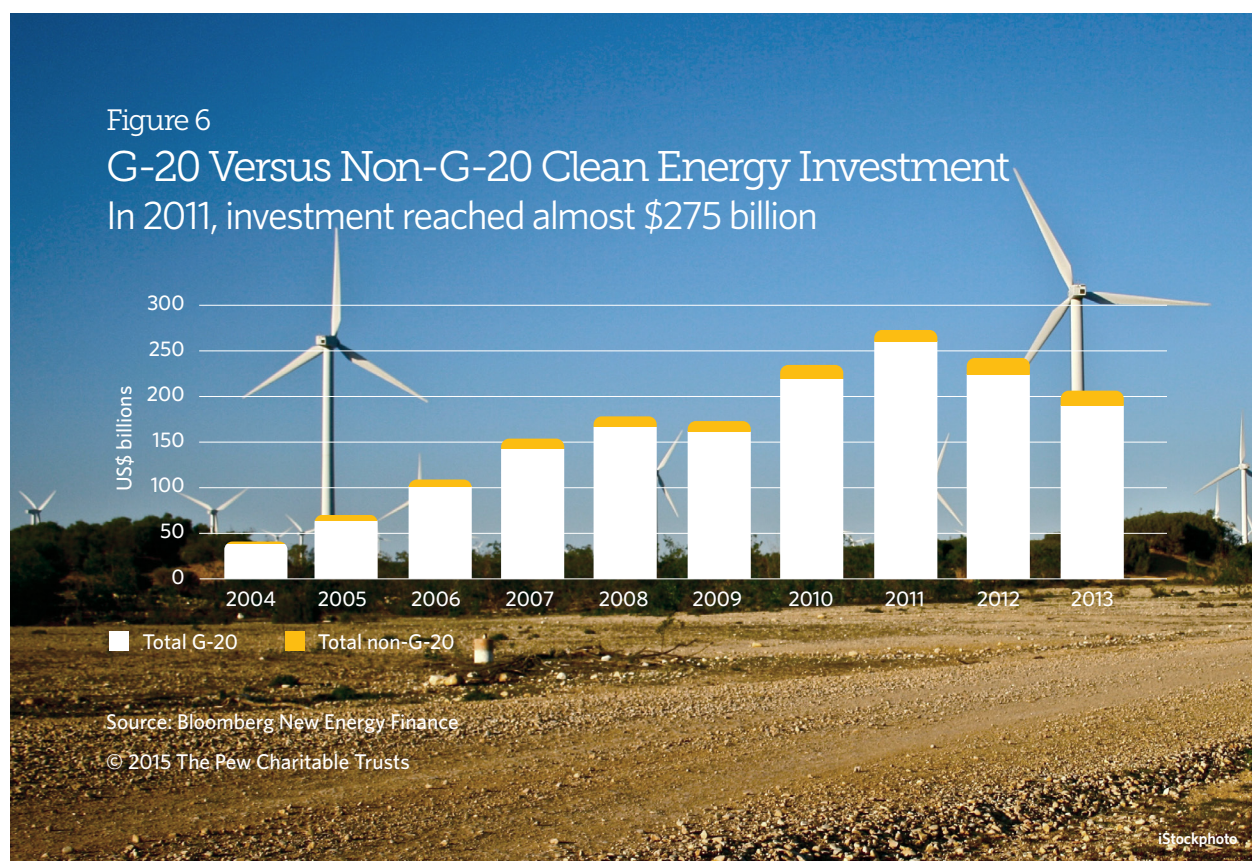


Source: Bloomberg New Energy Finance

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Clean energy investment in emerging economies is small but growing

The recent rise in clean energy deployment and the associated cost reductions for key technologies have been fueled by strong investment. From 2009 to 2013, cumulative worldwide private investment in the sector totaled \$1.13 trillion. Countries outside the G-20 attracted \$75 billion, or 6.6 percent, of that amount, and that share has been increasing in real and relative terms. In 2013, these countries received \$16.7 billion (8 percent of global total) in clean energy investment, up from \$13.8 billion, or 5.8 percent of the global total, in 2011. Developing countries have helped to offset some of the impact of reduced investment in developed economies, such as Germany and Spain.



Wind power in Morocco.

Developing Asian nations lead emerging markets in clean energy investment

One hundred countries outside the G-20 and the OECD garnered \$62 billion in clean energy investments from 2009 to 2013, with much of it concentrated in a relatively small number of countries. In fact, almost half (45 percent)—\$27.9 billion—of the total five-year investment occurred in just 10 emerging clean energy markets.

The data show that financial support for clean energy across the top 10 emerging markets follows investment patterns observed in developed nations, ebbing and flowing with changes in policies and project development schedules.

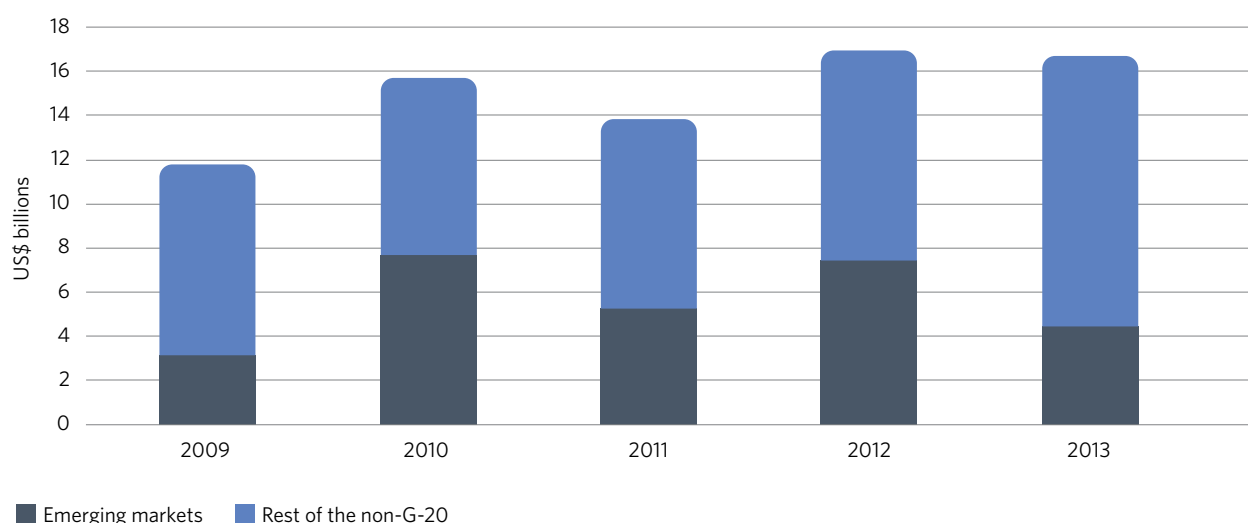
45% Proportion of total five-year investment in emerging clean energy markets that occurred in just 10 nations

The top 10 most attractive emerging markets for clean energy investment spanned four continents from 2009 to 2013, but half were located in East and Southeast Asia. Thailand was the leader, attracting \$5.6 billion over the five-year period. Bulgaria and Ukraine accounted for almost \$8 billion, garnering \$4.6 billion and \$3.3 billion, respectively. Kenya was fourth with \$2.6 billion, and Peru was fifth with \$2.2 billion. Taiwan, Morocco, Vietnam, Pakistan, and the Philippines rounded out the top 10.

The solar industry led all renewable sectors from 2009 to 2013, attracting \$12 billion—43 percent of the total. Thailand and Bulgaria received the most solar investment, more than \$3 billion each for large-scale installations of more than 1 MW. The wind industry reaped the second-greatest sum at \$7.7 billion. Every country in the top 10 garnered investments for wind projects, but Pakistan, Bulgaria, and Ukraine led the way, attracting more than \$1 billion each. Together, solar and wind acquired more than 70 percent of all clean energy investment in emerging markets—43 and 28 percent, respectively.

Other renewable sectors also received significant investment. More than \$2.2 billion was invested in the biofuels and geothermal sectors; Kenya received almost all of the geothermal investment, and Peru and Thailand each realized more than \$600 million for biofuels projects. Vietnam led the small hydro category, bringing in \$1.2 billion of the nearly \$2.1 billion invested in this sector across the top 10.

Figure 7
Non-G-20 Clean Energy Investment, 2009-13
Nearly half was in the top 10 emerging markets



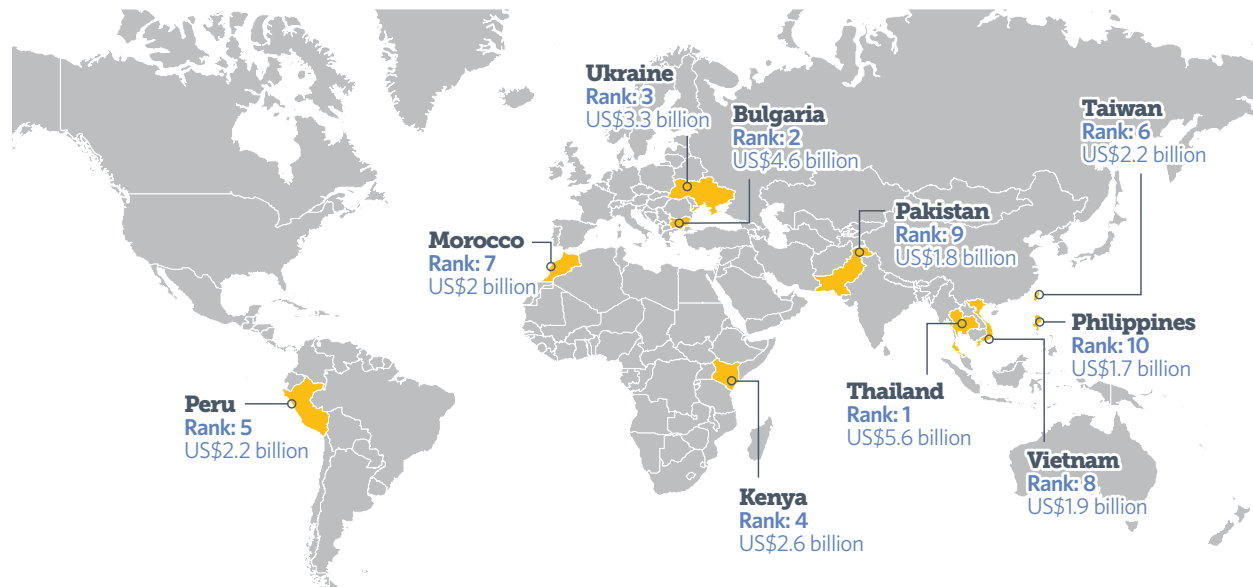
Source: Bloomberg New Energy Finance

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Figure 8

Clean Energy Investment, 2009-13

Thailand leads, while Bulgaria and Ukraine account for almost \$8 billion



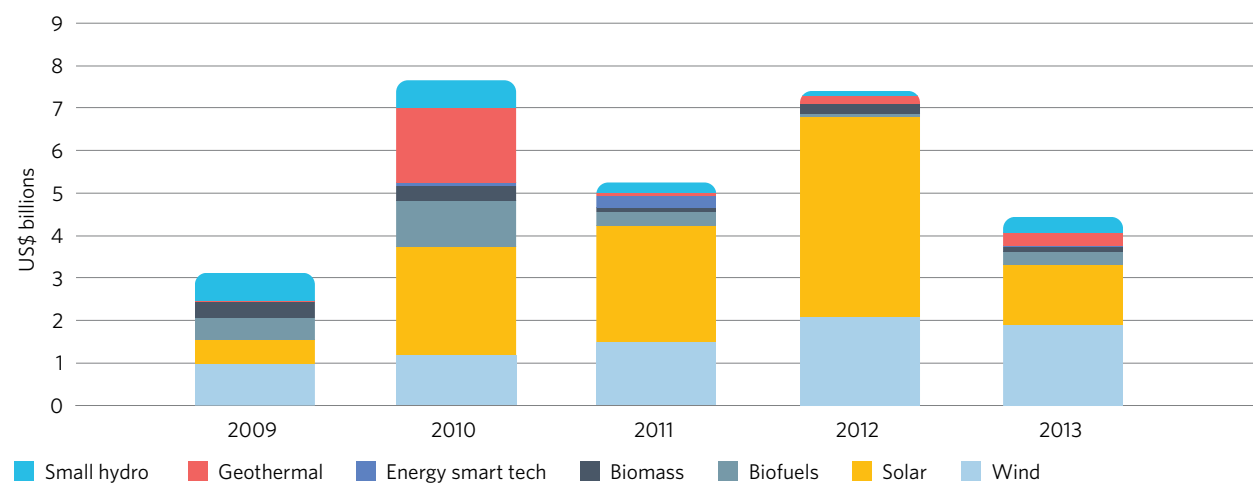
Source: Bloomberg New Energy Finance

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Figure 9

Clean Energy Investment in the Top 10 Emerging Markets, by Technology

Solar and wind lead investment in these nations



Source: Bloomberg New Energy Finance

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Figure 10

Clean Energy Investment by Country and Technology, 2009-13 (in US\$ millions)

Every country among the top 10 garnered wind investment

Country	Solar	Wind	Geothermal	Small hydro	Biomass	Biofuels	Energy smart technologies
Bulgaria	\$3,189	\$1,415					
Kenya	\$1.6	\$185.4	\$2,050	\$73.5		\$247	
Morocco	\$1,179	\$844					
Pakistan		\$1,635		\$67	\$60		
Peru	\$410	\$251		\$673	\$147	\$749	
Philippines	\$40	\$792	\$270	\$34	\$317	\$246	
Taiwan	\$1,421	\$329					\$400
Thailand	\$3,863	\$555		\$58	\$513	\$639	
Ukraine	\$1,927	\$1,225			\$92	\$81	
Vietnam		\$420		\$1,154	\$73	\$287	
Total	\$12,031	\$7,651	\$2,320	\$2,059	\$1,202	\$2,248	\$400

Source: Bloomberg New Energy Finance

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A solar array in Crimea, Ukraine.

Emerging Markets Are Targets for U.S. Clean Energy Exports

The U.S. government has bolstered its work to support American businesses in identifying and facilitating export opportunities in the expanding global market for clean energy technologies. The Trade Promotion Coordinating Committee, an interagency working group chaired by the secretary of commerce, created a Renewable Energy and Energy Efficiency Export Initiative (RE4I) in 2010 to help coordinate and expand U.S. clean energy efforts as part of the nation's overall National Export Initiative. RE4I seeks to mobilize financing for export activities by U.S. companies, open international markets to U.S. clean energy goods and services, and promote trade opportunities overseas. Among the 12 agencies that participate in the initiative:

The Export-Import Bank is a self-sustaining, independent agency that provides medium- and long-term loans and loan guarantees to foreign purchasers buying goods and services with significant U.S. content. From 2009 to 2013, the bank authorized more than \$1.7 billion worth of renewable energy export financing.

The Overseas Private Investment Corp. is also self-sustaining and independent. It provides short- and medium-term loans and political risk insurance to small U.S. businesses exporting overseas in support of development projects. In 2013, the corporation committed \$1.2 billion toward clean energy projects.

The Trade Development Agency is an independent agency that finances trade missions and feasibility studies to help U.S. businesses identify opportunities and compete for foreign contracts.

Deployment of clean energy dwarfs that of fossil energy in emerging markets from 2009 to 2013

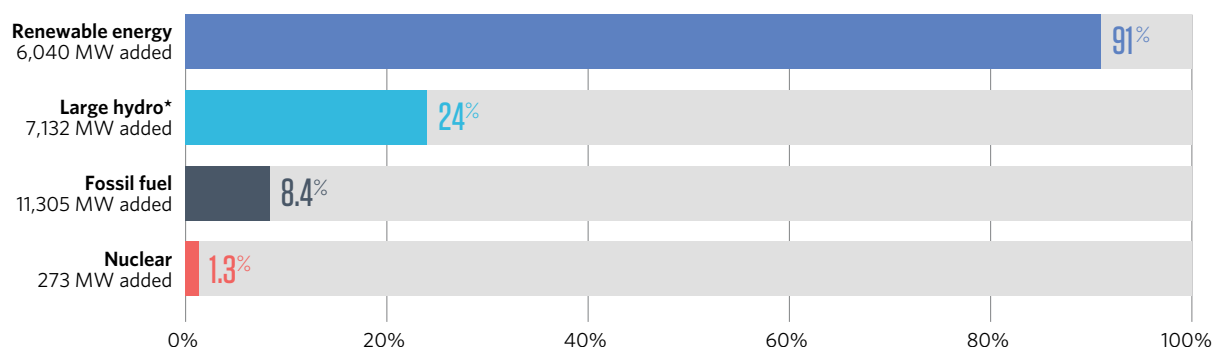
Although the majority—67 percent—of installed capacity in the top 10 emerging markets is still conventional fossil fuel-powered, deployment of new fossil generation technologies grew by less than 10 percent between 2009 and 2013. By contrast, clean energy installations in those countries expanded by 91 percent during the same period, more than twice as fast as all other technologies combined.

Each of the top 10 emerging markets added wind, solar, biomass, geothermal, or small hydro capacity from 2009 to 2013, and seven added large hydro projects. By contrast, only five added fossil fuel generation, and just one built nuclear power plants.

Figure 11

Growth of Capacity in the Top 10 Emerging Markets, 2009-13

Renewable energy sector leads market expansion



* Projects greater than 50 MW.

Source: Bloomberg New Energy Finance

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Figure 12

Growth of Power Capacity by Country and Technology, 2009-13 (in megawatts)

Emerging markets added wind, solar, biomass, geothermal, or small hydro capacity

Country	Renewable	Small hydro	Fossil	Nuclear
Bulgaria	1,537	82		
Kenya	88	156	202	
Morocco	229		1,628	
Pakistan	154	252	4,071	325
Peru	236	173	2,427	
Philippines	76	132		
Taiwan	600			-52
Thailand	1,363	1,800		
Ukraine	1,271			
Vietnam	486	4,537	2,977	
Total	6,040	7,132	11,305	273

Source: Bloomberg New Energy Finance

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Three countries—Bulgaria, Thailand, and Ukraine—added more than 1 GW of renewable energy capacity. In Bulgaria, 1.5 GW of new renewable energy (and 82 MW of hydropower) were installed between 2009 and 2013, the most among the top 10 emerging markets. Thailand added 1.4 GW of renewable energy and another 1.8 GW of hydropower. In Ukraine, installed clean energy increased by more than 6,700 percent from 2009 to 2013, growing from 20 MW to almost 1.3 GW. Vietnam installed the most capacity overall, almost 8 GW, including 4.5 GW of hydropower, 3 GW of fossil fuel-powered systems, and more than 485 MW of renewable energy.

Solar accounts for more than half of clean energy additions in emerging markets

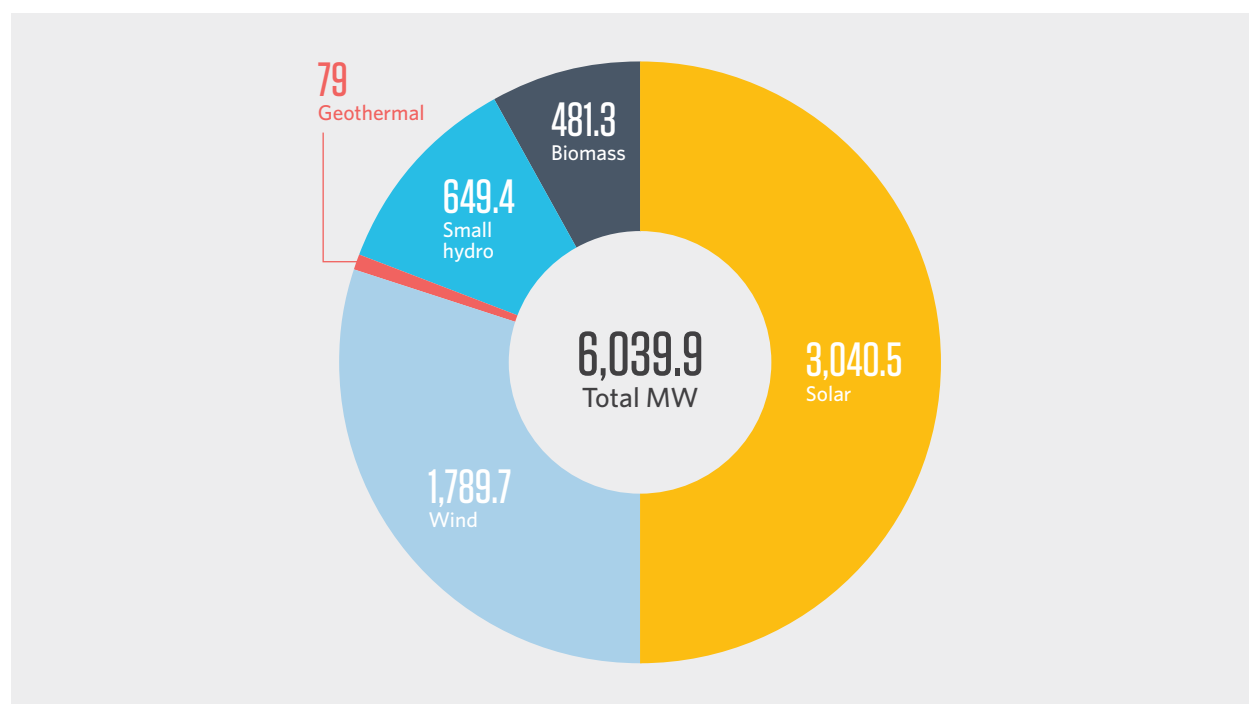
Within the renewable energy category, solar grew the most across the top 10 nations. Together, six countries added 3 GW of solar generation from 2009 to 2013. Bulgaria (955 MW), Thailand (808 MW), and Ukraine (780 MW) accounted for the bulk of these additions.

Those three countries also installed the most new wind turbines. Overall, eight of the 10 countries installed wind energy (1.8 GW). More than 649 MW of small hydro was added in seven countries, much of it in Vietnam. Biomass grew by 481 MW, mostly in Thailand, and Kenya accounted for nearly all of the new geothermal plants.

Figure 13

Percentage of Clean Energy Capacity Additions in the Top 10 Emerging Markets, by Technology (in megawatts)

Solar leads development in non-G-20 nations



Source: Bloomberg New Energy Finance

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Figure 14

Growth of Clean Energy Capacity by Country and Technology, 2009-13 (in megawatts)

Solar generating capacity increased the most across emerging markets

Country	Solar	Wind	Geothermal	Small hydro	Biomass
Bulgaria	955	564		18	
Kenya		5	78.5	-7	12
Morocco	20	168		41	
Pakistan	84	100		19	35
Peru				94	59
Philippines				17	58
Taiwan	393	206	0.5		
Thailand	808	242		11	301
Ukraine	780	475			16
Vietnam		30		456	
Total	3,040	1,790	79	649	481

Source: Bloomberg New Energy Finance

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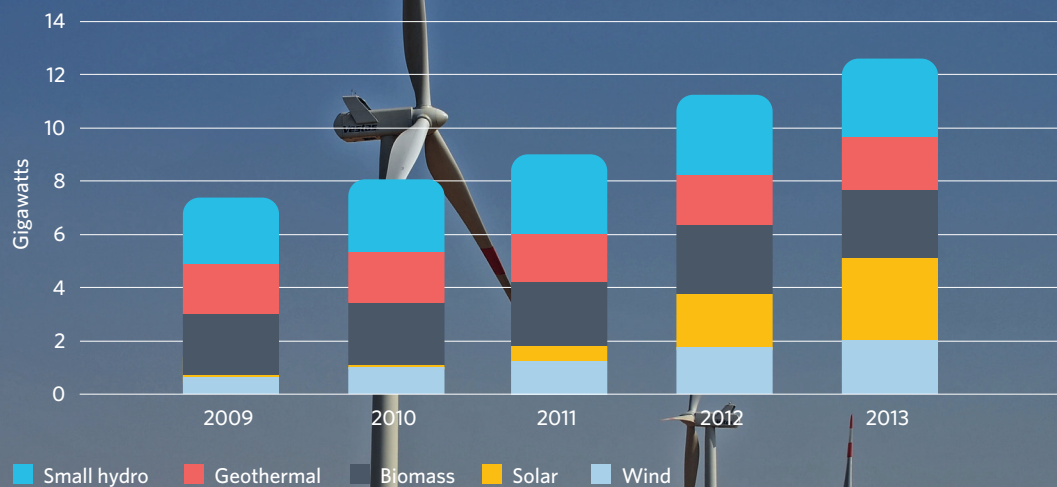


A wind farm in Jhimpir, Pakistan.

Figure 15

Total Installed Clean Energy Capacity in the Top 10 Emerging Markets, 2009-13

Amount reached almost 13 GW



Source: Bloomberg New Energy Finance

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Muzaffar Bukhari/Flickr

Wind project northeast of Karachi, Pakistan.

Conclusion

Because they are clean, rely on readily available natural resources, and are increasingly cost competitive, wind, solar, geothermal, small hydropower, and biomass energy are projected to claim more than 60 percent of the total energy investment through 2030 and account for a similar share of new power installations. The majority of this additional investment and capacity will occur in emerging economies in Asia, Latin America, and Africa, as nations in these regions seek to reduce energy poverty and fuel development.

Over the past decade, the clean energy industry has grown in scale and scope and is now operating in virtually every country worldwide. This report shows the geographic and technological diversity of national interests in renewables. Developing countries across the globe are exploring clean energy options to help support economic, environmental, and energy security objectives.

66% Amount of total energy investment expected to be in renewable energy through 2030

Appendix: Methodology

All figures in this report, unless otherwise credited, are based on the output of Bloomberg New Energy Finance's Desktop database and analysis by its regional and sector experts. Data are current as of the end of 2014 and are categorized by country.

The Bloomberg New Energy Finance Desktop is a Web-based database of clean energy and energy smart technology companies, manufacturing facilities, generation projects, and financial deals that are organized according to transaction type, sector, geography, and timing. The database includes 30,000 transactions, 32,000 renewable energy projects, and more than 50,000 organizations—including start-ups, corporations, venture capital and private equity providers, banks, and other investors. It is available by subscription at <http://www.bnef.com>.

The data in this report track asset finance—investment in renewable energy projects—aggregated with funds raised by pure play clean energy companies both from venture capital and private equity and on the public capital markets. Because this is financial investment, corporate and government research and development are excluded, and because it is new investment, acquisitions, private equity buyouts, and public market exits are also omitted.

Among the types of financing covered in this report:

Venture capital and private equity include money invested by venture capital funds in companies developing renewable energy technology, typically at the innovation stage when companies are proving the market potential of goods and services.

Public markets include money invested in publicly traded companies that are developing renewable energy technology or clean power generation. Public market financing is typically associated with the scale-up phase, when companies are raising capital in public stock markets to finance product manufacturing and rollout. Investment in companies setting up generating capacity is included in asset finance.

Asset finance includes money invested in projects for renewable energy generation, whether from internal company balance sheets, debt finance, or equity finance, and excludes refinancing and short-term construction loans. Asset financing is associated with installation of clean energy equipment and with generating capacity.

Reinvested equity isolates values for balance-sheet, or asset, financed project investments by companies that have raised money through venture capital and private equity investors or on the capital markets over the past 12 months. The purpose of this calculation is to prevent double counting upon aggregation of project investments and company investments when calculating total new financial investment in clean energy.

Among the clean energy technologies tracked in this report:

Wind power is the extraction of kinetic energy from the wind and the conversion of it into usable energy. Included in this sector are players across the entire value chain of onshore and offshore developments, from manufacturers of turbines, components, and subassemblies to developers, generators, utilities, and engineering firms.

Solar includes all technologies that capture energy directly from the sun. These include production of electricity using semiconductor-based photovoltaic materials, solar thermal electricity generation (the use of concentrated sunlight to heat fluid to drive power generation equipment), and passive methods that use solar to replace fossil fuel energy (e.g., to heat water).

Biofuels are liquid transportation fuels such as biodiesel and bioethanol. These can be derived from a range of biomass sources, including sugar cane, rapeseed (canola), soybean oil, and cellulose. The source database for this analysis excludes producers of base biomass but includes suppliers of the processing technologies and equipment, logistics of distribution, manufacturers of energy systems that are specially adapted for the use of biofuels and products, and the services on which they depend.

Biomass and waste are the production and consumption of solid and gaseous fuels derived from solid plant material, including specially grown crops, such as elephant grass or coppiced willow, as well as crop residues such as straw. We include in this sector processors of other waste matter for energy generation, such as sewage waste, chemical byproducts, and biogas produced from municipal waste, because their exploitation often involves the same technologies as grown-for-purpose biomass.

Energy smart technologies cover a range of nonrenewable clean energy technologies, including digital energy and smart grids, power storage, hydrogen and fuel cells, advanced transportation, and energy efficiency on both the demand and supply sides.

Other renewables include small hydro, the generation of electric power from the movement of water with capacities between 1 and 50 MW; geothermal, the extraction of useful power from heat stored in the earth; and marine, the extraction of energy from the sea.

Bloomberg New Energy Finance continuously monitors investment in renewable energy and energy efficiency, which is a dynamic process. As the sector's visibility grows, information flow improves, and as new deals are made and existing data are refined, historical figures are constantly updated.

Note on large hydropower capacity data: In the interest of examining how clean energy (as defined in Bloomberg New Energy Finance's database) compares with other electric generation technologies, this report also presents deployment data on fossil, nuclear, and large hydropower generating capacity. Large hydropower refers to the generation of electric power from the movement of water at projects of more than 50-MW capacity. Opinions vary about whether large hydropower projects are considered clean or renewable, given the potentially significant social and environmental impact associated with construction of such projects. Therefore, the data presented here include small hydropower within the clean energy category but separate deployment figures for large hydropower facilities into its own category.

Bulgaria

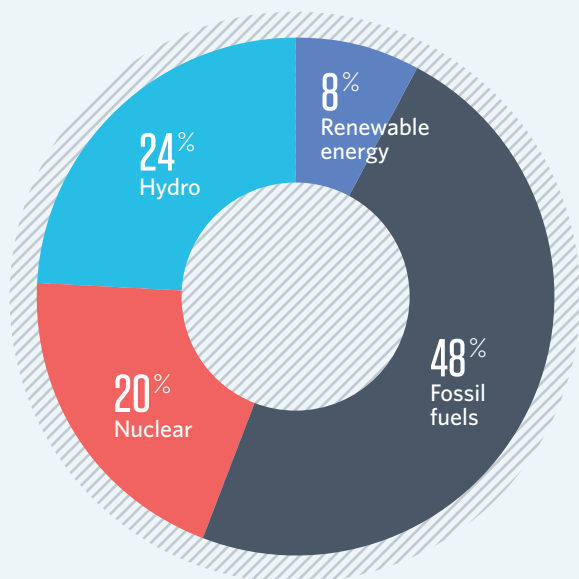
Bulgaria's clean energy sector received \$4.6 billion in investments from 2009 to 2013, second among the top 10 emerging markets. The country installed the greatest amount of clean energy capacity—more than 1.5 GW—over that period, including the most solar power and second-most wind power. Over the five years, \$3.2 billion was invested in solar, more than two-thirds of Bulgaria's total and the second-greatest amount in the top 10 countries. At \$1.4 billion, the wind sector accounted for the remainder of the country's total and was also second most among the top 10.

Clean energy investment was virtually nonexistent in Bulgaria a decade ago. However, as part of its acceptance into the European Union, the country assumed the EU's renewable energy goal of reaching 16 percent of consumption by 2020, an increase from 11 percent in 2010. Activity in the sector exploded as the government initiated policies to spur investment and deploy renewable generation. A feed-in-tariff program started in May 2008, after which renewable energy projects increased from less than 100 MW in 2007 to more than 2.2 GW by the end of 2012. During that time, the country installed 500 MW of solar and 200 MW of wind generating capacity.

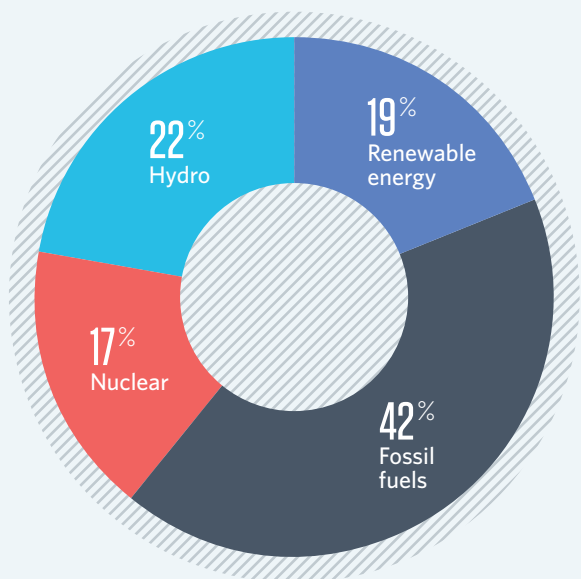
From late 2011 through 2012, however, the Bulgarian government began to roll back clean energy incentives, and as a result, investments have declined sharply. Still, 2020 targets for solar and other clean energy technologies have been reached ahead of schedule. Bulgaria ranks as the 66th overall renewable energy market, according to the U.S. International Trade Administration.

Demographics		Clean energy targets	
Population	7 million	Renewable energy	16% share of electric generation by 2020
Gross domestic product	\$53 billion	Clean energy policies	
Access to electricity (2010)	100%	Access to the grid	
Finance and investment		Auction	
Total clean energy investment, 2009-13	\$4.6 billion	Feed-in tariffs	✓
Emerging market rank	2	Government loans and incentives	✓
Share of emerging market total	16%	Net metering	
Installed energy		Renewable portfolio standard	
Total installed power capacity	11.7 GW	Tax credits and incentives	
Total clean energy capacity	2.2 GW	Tendering	
Clean energy share of capacity	18%	Tradable permits	
5-year growth in clean energy capacity	246%		

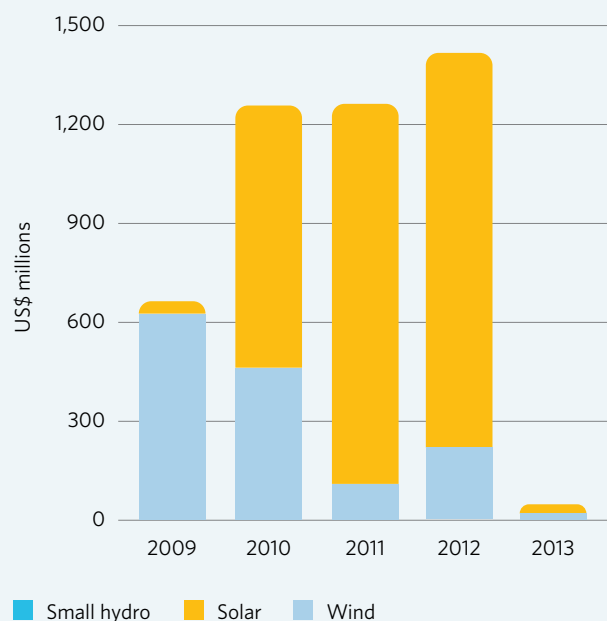
Installed Power Capacity by Technology, 2009



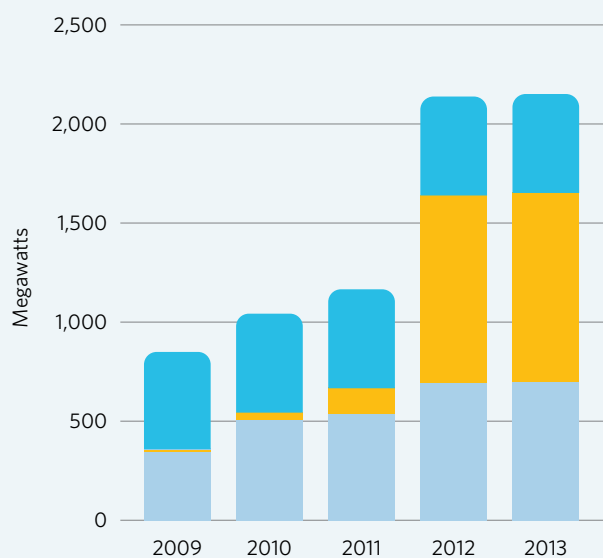
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Source: Bloomberg New Energy Finance

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Kenya

Kenya is home to the second-largest installed clean energy capacity in sub-Saharan Africa (after South Africa) and attracted \$2.6 billion in investment from 2009 to 2013. Because of its strong national commitment to reducing energy poverty, Kenya is a promising long-term renewable energy market. The U.S. International Trade Administration ranks it 13th overall, first for geothermal, and ninth for wind technologies.

During the same period, geothermal energy technologies garnered \$2.1 billion in Kenya, more than 80 percent of the country's total and enough to lead the rest of the emerging markets in terms of investment and installation. The biofuels sector was the country's second-largest recipient over the period, with \$247 million, just shy of 10 percent of total investments. Wind attracted \$185 million. Kenya is home to just over 400 MW of renewable energy and 725 MW of hydropower.

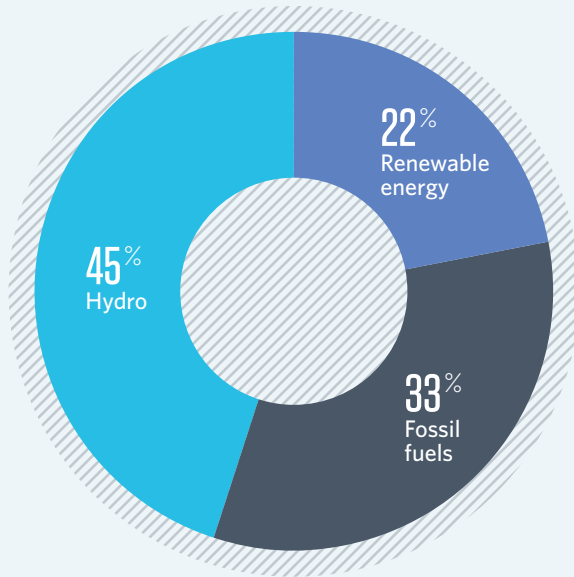
Only 26 percent of Kenya's citizens have access to modern energy services. The government's Vision 2030 initiative aims to achieve universal access to these services by 2030. As part of its efforts, the country plans to deploy 5.3 GW of geothermal energy, 3 GW of wind, and 4 GW of nuclear energy.

Kenya has several clean energy incentives, including feed-in tariffs and some tax and import exemptions. Pending legislation would make it the first country in sub-Saharan Africa to adopt a net metering policy and would support efforts to deploy 5 GW of renewable energy in less than four years. The nation is also one of the only countries in Africa with a photovoltaic manufacturing facility.

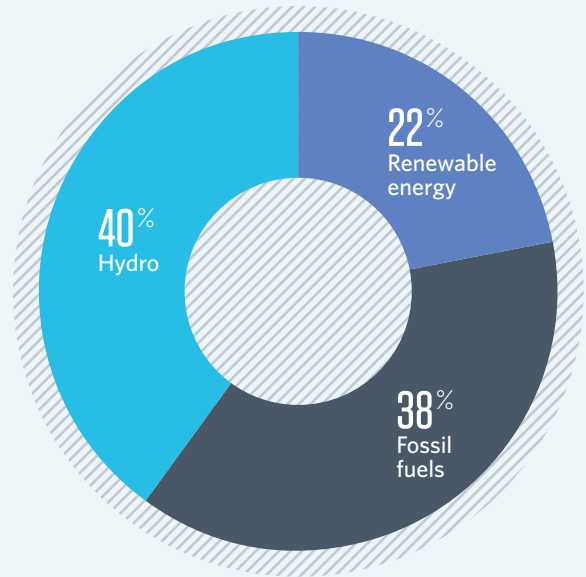
Demographics		Clean energy targets	
Population	45 million	Geothermal	1.9 GW by 2016, 5.2 GW by 2030
Gross domestic product	\$44.1 billion	Hydro	794 MW by 2016
Access to electricity (2010)	23%	Solar	423 MW by 2016
Finance and investment		Wind	635 MW by 2016, 3 GW by 2030
Total clean energy investment, 2009-13	\$2.6 billion	Clean energy policies	
Emerging market rank	4	Access to the grid	✓
Share of emerging market total	9%	Auction	
Installed energy		Feed-in tariffs	✓
Total installed power capacity	1.8 GW	Government loans and incentives	✓
Total clean energy capacity	403 MW	Net metering	
Clean energy share of capacity	22.4%	Renewable portfolio standard	
5-year growth in clean energy capacity	28%	Tax credits and incentives	✓
		Tendering	✓
		Tradable permits	



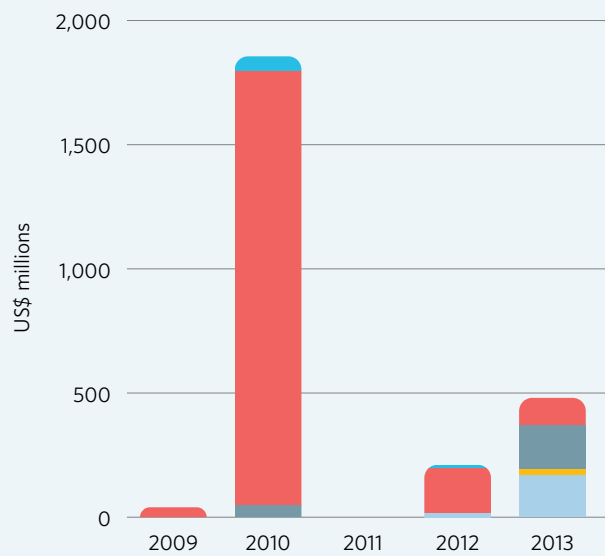
Installed Power Capacity by Technology, 2009



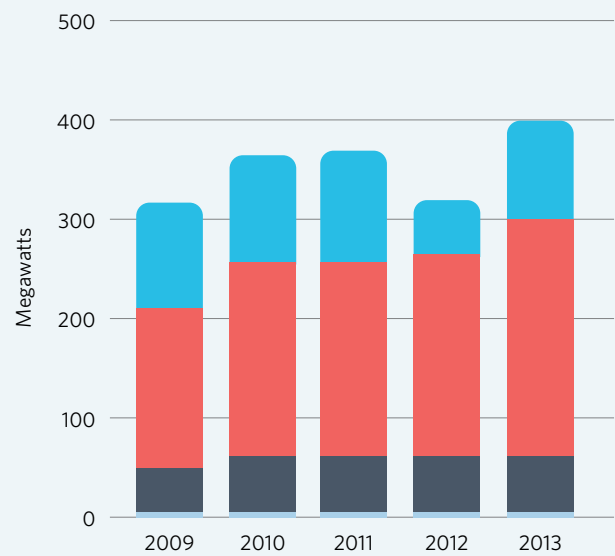
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



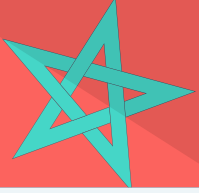
Total Installed Clean Energy Capacity, 2009-13



Small hydro Geothermal Biomass Biofuels Solar Wind

Source: Bloomberg New Energy Finance

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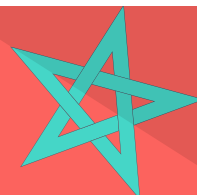
Morocco

Motivated by concerns about energy security, economic development, and poverty reduction, Morocco has made increasing clean energy-generating resources a priority in recent years. From 2009 to 2013, more than \$2 billion was invested in clean energy technologies, and 166 MW of capacity was installed. Almost 60 percent of the total investment, or \$1.2 billion, went to solar technologies, the fourth-highest figure among the top 10 emerging markets. Morocco's wind sector received \$844 million over the same five-year period.

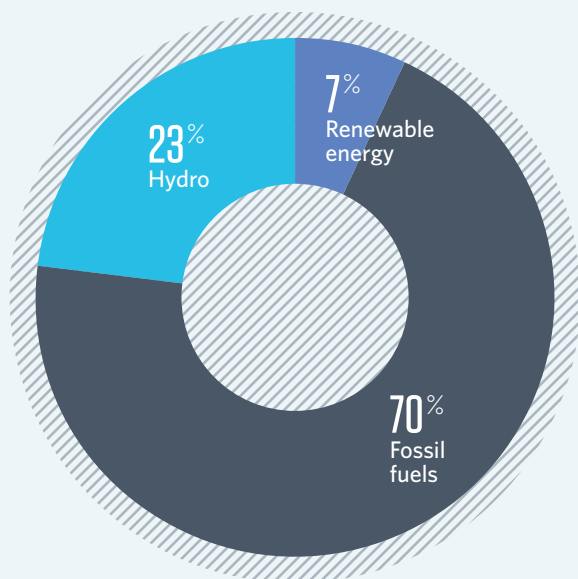
The country has set a goal of increasing renewable energy to 20 percent of consumption by 2020, which would require clean technologies to reach 42 percent of installed capacity by that time. A number of significant projects are under development, including a 2-MW photovoltaic plant (which would be the nation's largest); a 160-MW concentrated solar power project; and two 50-MW wind farms. The government has also encouraged industrial facilities to develop renewable energy projects in order to meet their energy needs.

The U.S. International Trade Administration ranks Morocco as the 54th overall market for clean energy, 20th in the hydropower sector, and 34th in the wind sector.

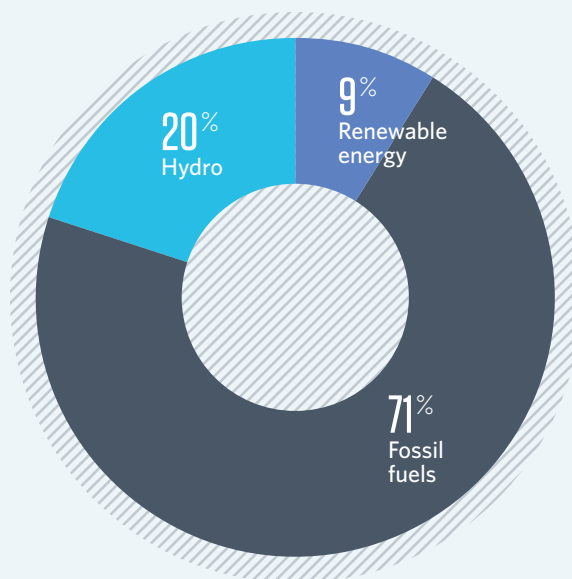
Demographics		Clean energy targets	
Population	33 million	Renewable energy	Clean energy and large hydro: 42% of total electric capacity by 2020
Gross domestic product	\$104.3 billion	Solar	2 GW by 2020
Access to electricity (2010)	99%	Wind	2 GW by 2020
Finance and investment		Clean energy policies	
Total clean energy investment, 2009-13	\$2 billion	Access to the grid	✓
Emerging market rank	7	Auction	
Share of emerging market total	7%	Feed-in tariffs	
Installed energy		Government loans and incentives	✓
Total installed power capacity	7.2 GW	Net metering	
Total clean energy capacity	631 MW	Renewable portfolio standard	
Clean energy share of capacity	8.8%	Tax credits and incentives	
5-year growth in clean energy capacity	57%	Tendering	✓
		Tradable permits	



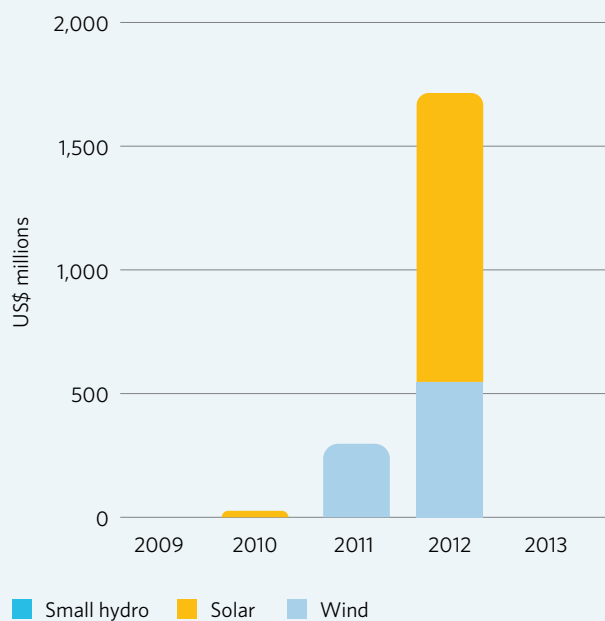
Installed Power Capacity by Technology, 2009



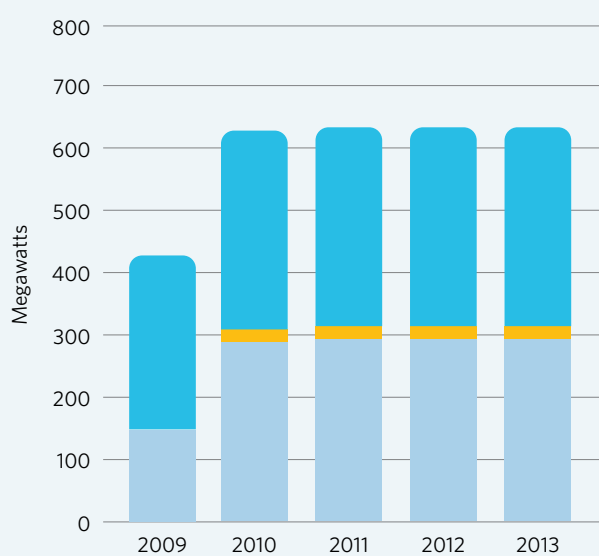
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Source: Bloomberg New Energy Finance

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Pakistan

Pakistan's clean energy sector garnered \$1.8 billion worth of investment from 2009 to 2013. Of this total, more than 90 percent—\$1.6 billion—funded wind energy technologies. Reflecting the country's favorable resource, 100 MW of wind capacity was added from 2009 to 2013. The biomass and small hydro sectors garnered about \$60 million each. Installed small hydro expanded by more than 19 MW.

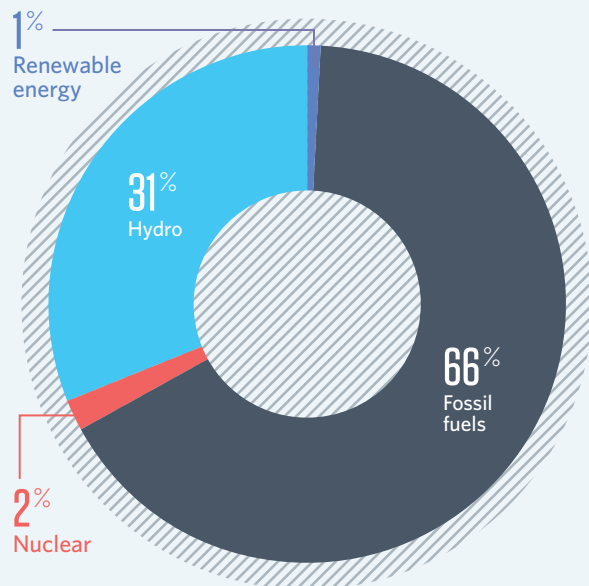
The government of Pakistan has set a goal of obtaining 5 percent of its total energy from renewables by 2030. It has established feed-in tariffs for grid-connected solar photovoltaic and wind projects.

The U.S. International Trade Administration ranks Pakistan 71st among the 75 countries it reviewed, mirroring the nation's modest clean energy goals.

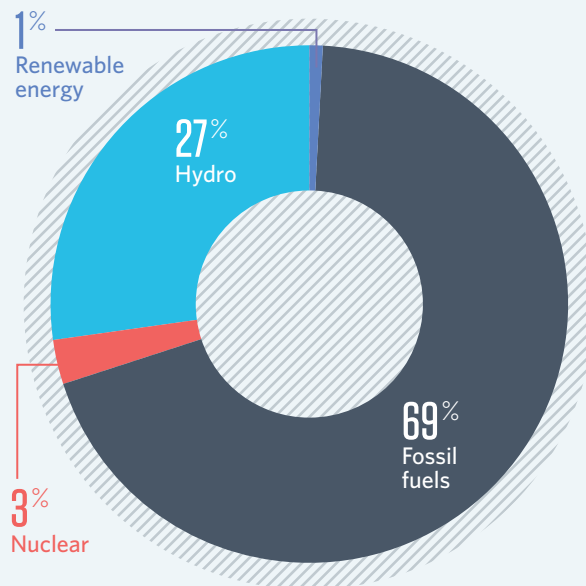
Demographics		Clean energy targets	
Population	196 million	Renewable energy	5% of energy use by 2030
Gross domestic product	\$236.6 billion	Clean energy policies	
Access to electricity (2010)	91%	Access to the grid	
Finance and investment		Auction	
Total clean energy investment, 2009-13	\$1.8 billion	Feed-in tariffs	✓
Emerging market rank	9	Government loans and incentives	✓
Share of emerging market total	6%	Net metering	✓
Installed energy		Renewable portfolio standard	
Total installed power capacity	25 GW	Tax credits and incentives	
Total clean energy capacity	273 MW	Tendering	
Clean energy share of capacity	1.1%	Tradable permits	
5-year growth in clean energy capacity	129%		



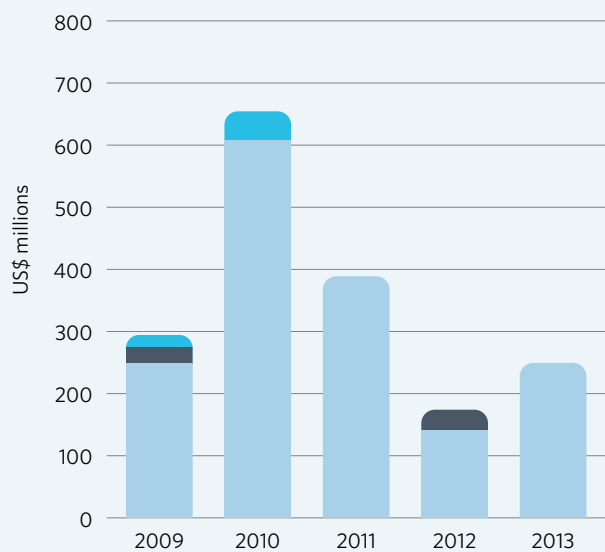
Installed Power Capacity by Technology, 2009



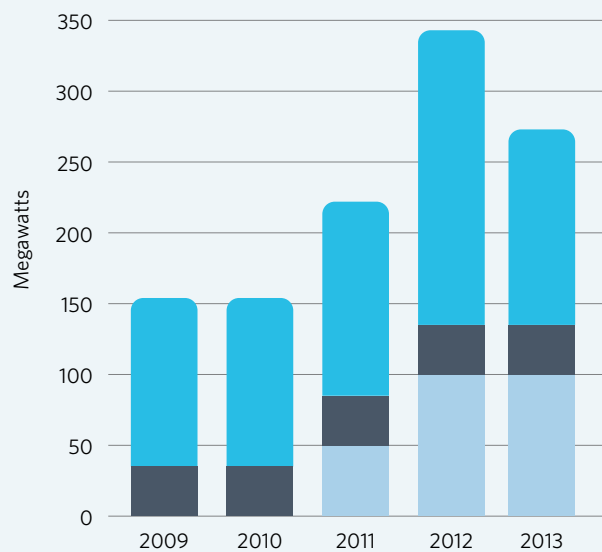
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Small hydro Biomass Wind

Source: Bloomberg New Energy Finance

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Peru

Peru attracted \$2.2 billion in clean energy investment from 2009 to 2013, the fifth-highest amount among the top 10 emerging markets, with investment spread over a range of technologies. The biofuels sector garnered one-third of the total, or \$749 million, the most among the developing countries examined. The small hydro sector received \$673 million over the period, the second-highest figure among the emerging markets, followed by the solar industry with \$410 million and wind energy technologies at \$251 million.

Peru led all South American countries in installed capacity until Chile took the lead in 2014. Since 2009, the government has conducted contracting bid auctions for clean energy projects as a key strategy for spurring deployment of these technologies. In 2013, the country auctioned contracts for 240 MW worth of small hydro projects.

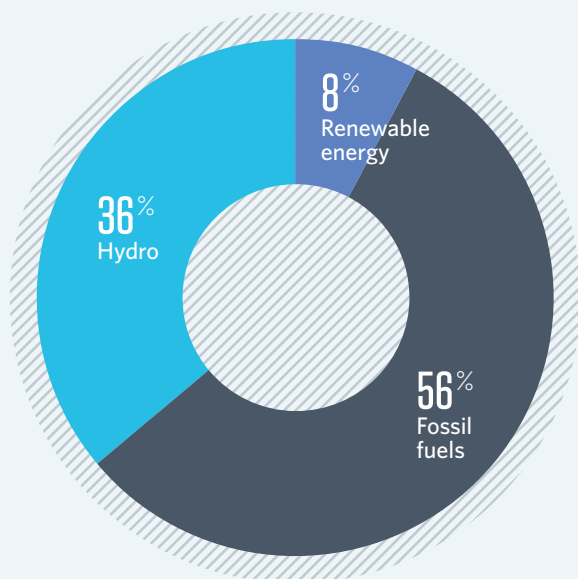
The government evaluates the need for auctions for large-scale clean energy projects every two years, and the country is working to encourage development of off-grid solar and wind projects in underserved rural areas. Peru's duties on imported renewable energy technologies are among the lowest of all developing countries.

The U.S. International Trade Administration ranks Peru as the eighth overall market for clean energy, 24th for solar, and 28th for wind.

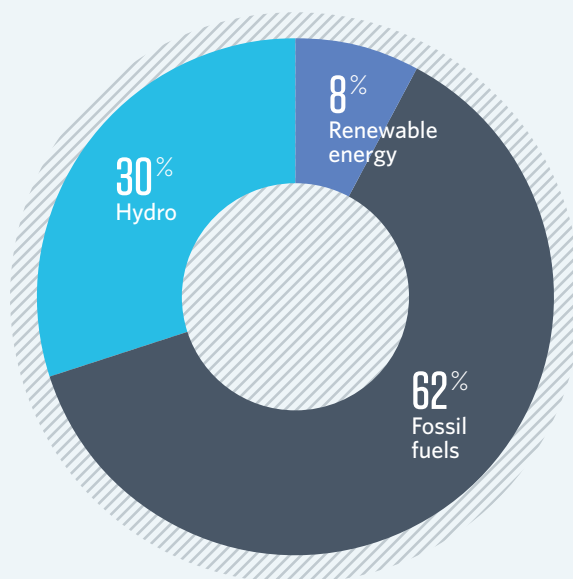
Demographics		Clean energy targets	
Population	30 million	Renewable energy	5% of total power consumption by 2013
Gross domestic product	\$202 billion	Clean energy policies	
Access to electricity (2010)	85%	Access to the grid	✓
Finance and investment		Auction	✓
Total clean energy investment, 2009-13	\$2.2 billion	Feed-in tariffs	
Emerging market rank	5	Government loans and incentives	✓
Share of emerging market total	8%	Net metering	
Installed energy		Renewable portfolio standard	
Total installed power capacity	10 GW	Tax credits and incentives	
Total clean energy capacity	756 MW	Tendering	
Clean energy share of capacity	7.8%	Tradable permits	
5-year growth in clean energy capacity	46%		



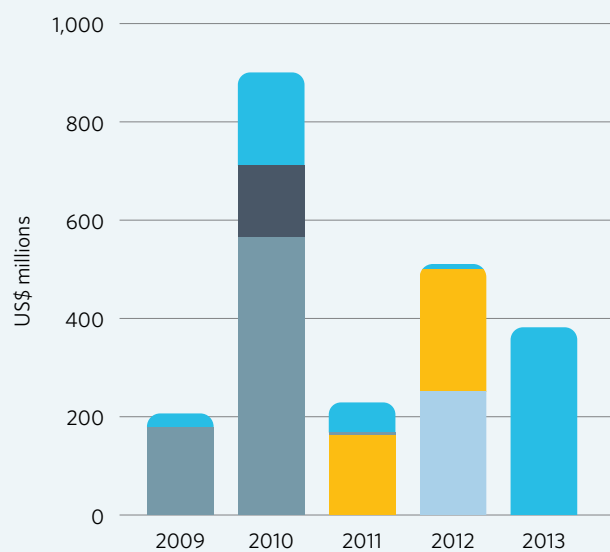
Installed Power Capacity by Technology, 2009



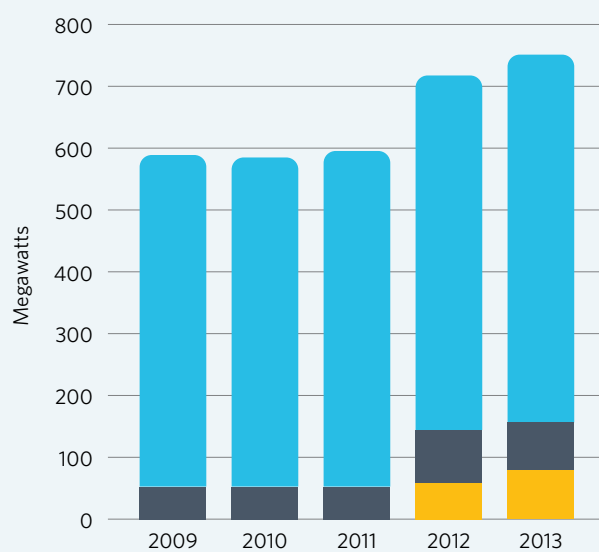
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



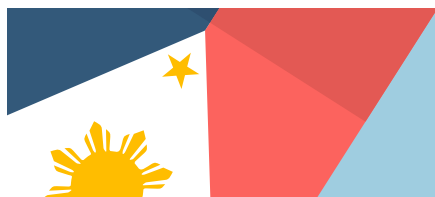
Total Installed Clean Energy Capacity, 2009-13



■ Small hydro ■ Biomass ■ Biofuels ■ Solar ■ Wind

Source: Bloomberg New Energy Finance

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Philippines

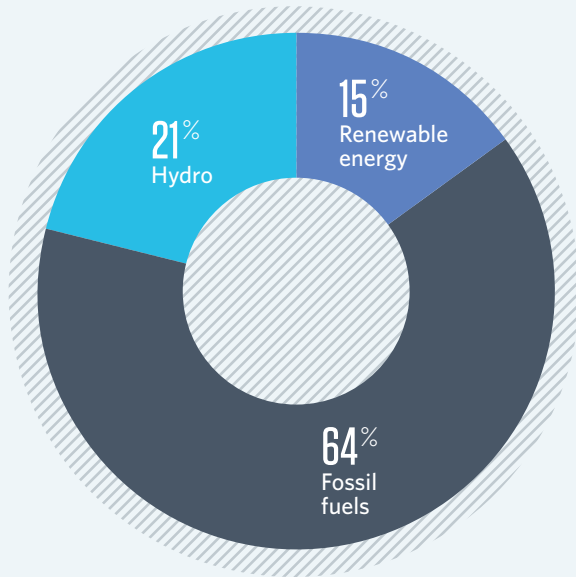
The Philippines attracted \$1.7 billion worth of clean energy investments from 2009 to 2013. The wind sector, with \$792 million invested, accounted for more than 46 percent of the total and ranked fifth among the top 10 emerging markets. Biomass technologies received \$317 million over the period, followed by the geothermal sector at \$269 million.

The Philippines' national energy plan calls for the addition of almost 10 GW of clean energy by 2030, of which more than half will come from large and small hydro, 2.3 GW will come from wind, and 1.5 GW will be geothermal. To spur deployment, the Philippines adopted feed-in tariffs in July 2012 for solar, wind, hydro, and biomass projects.

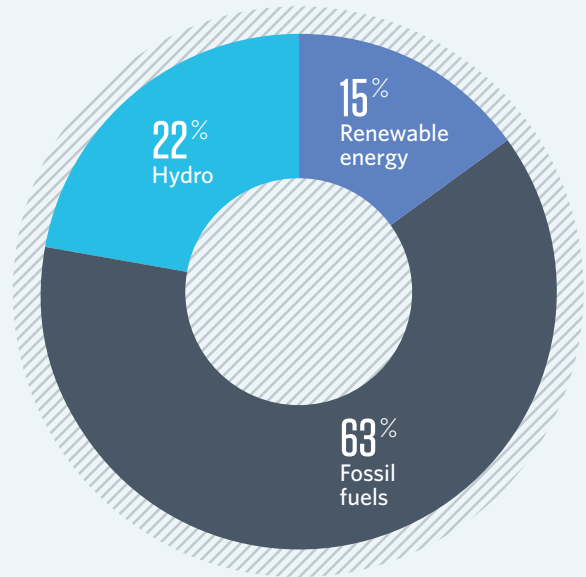
The U.S. International Trade Administration ranks the Philippines as the 10th leading emerging clean energy market overall, the sixth geothermal market, and the 11th wind energy market.

Demographics		Clean energy targets	
Population	107 million	Renewable energy	Clean energy and large hydro: 40% share of electric generating capacity by 2020; 50% by 2030
Gross domestic product	\$272 billion	Clean energy policies	
Access to electricity (2010)	83%	Access to the grid	
Finance and investment		Auction	
Total clean energy investment, 2009-13	\$1.7 billion	Feed-in tariffs	✓
Emerging market rank	10	Government loans and incentives	✓
Share of emerging market total	6%	Net metering	✓
Installed energy		Renewable portfolio standard	✓
Total installed power capacity	13.7 GW	Tax credits and incentives	✓
Total clean energy capacity	2 GW	Tendering	
Clean energy share of capacity	15%	Tradable permits	
5-year growth in clean energy capacity	4%		

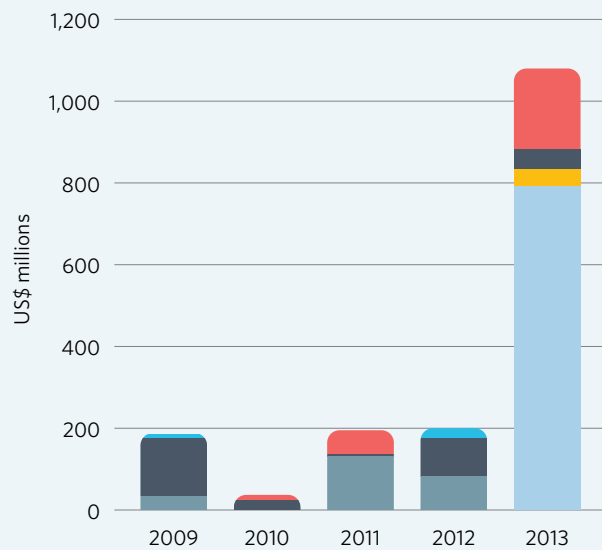
Installed Power Capacity by Technology, 2009



Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Small hydro Geothermal Biomass Biofuels Solar Wind

Source: Bloomberg New Energy Finance

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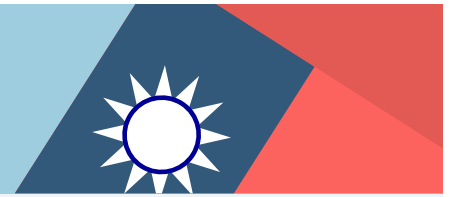
Taiwan

From 2009 to 2013, Taiwan attracted \$2.2 billion in clean energy investment, the sixth-highest amount among the top 10 emerging markets. Two-thirds of the total clean energy investment went to the solar sector, which garnered \$1.4 billion, the fourth-highest figure among the 10 countries studied. Taiwan's installed solar capacity increased by 367 MW over the five-year period. Energy smart technologies gained \$401 million in investment, and wind energy received \$329 million.

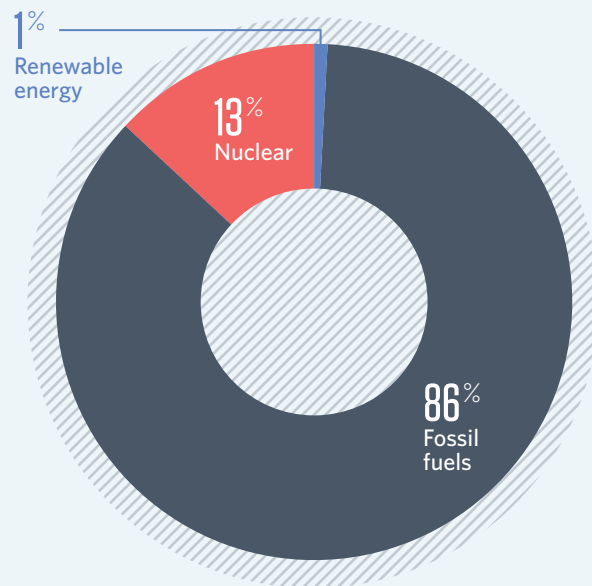
Taiwan is a major presence in the global market for photovoltaic cell manufacturing, a position that has been greatly enhanced by a significant trade dispute between the United States and China. As a result, much of the investment in Taiwan's solar sector has aimed to increase manufacturing rather than generating capacity. However, growing antinuclear sentiment in Taiwan has led to a recalibration of the island's energy future toward employing more low-carbon, clean energy alternatives. A modest feed-in tariff for clean energy sources has not stimulated substantial additional clean energy projects.

The U.S. International Trade Administration ranks Taiwan as the 44th overall clean energy market and the 37th solar market.

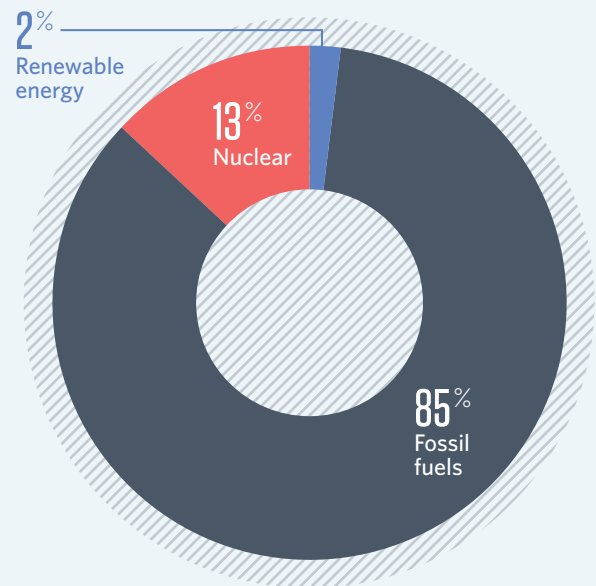
Demographics		Clean energy targets	
Population	23 million	Renewable energy	12% of electric generating capacity by 2020
Gross domestic product	\$485 billion	Clean energy policies	
Access to electricity (2010)	100	Access to the grid	
Finance and investment		Auction	
Total clean energy investment, 2009-13	\$2.2 billion	Feed-in tariffs	✓
Emerging market rank	6	Government loans and incentives	
Share of emerging market total	8%	Net metering	
Installed energy		Renewable portfolio standard	
Total installed power capacity	38.5 GW	Tax credits and incentives	
Total clean energy capacity	837 MW	Tendering	
Clean energy share of capacity	2.2%	Tradable permits	
5-year growth in clean energy capacity	253%		



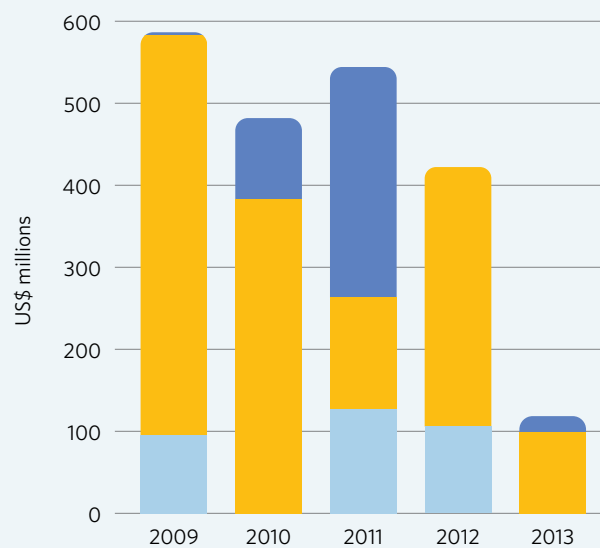
Installed Power Capacity by Technology, 2009



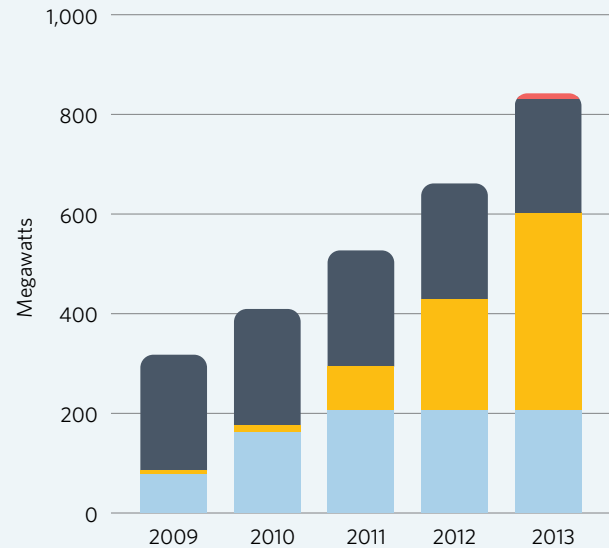
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Geothermal Energy smart tech Biomass Solar Wind

Source: Bloomberg New Energy Finance

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Thailand

Thailand attracted \$5.6 billion in clean energy investments from 2009 to 2013, the highest total of any of the emerging markets. Of this amount, almost 70 percent—\$3.9 billion—targeted the solar sector, which added 808 MW worth of capacity. Biofuels gained \$639 million, followed by the wind sector, which received \$555 million and added 242 MW worth of turbines. The biomass sector garnered \$513 million, the most among the top 10 emerging markets.

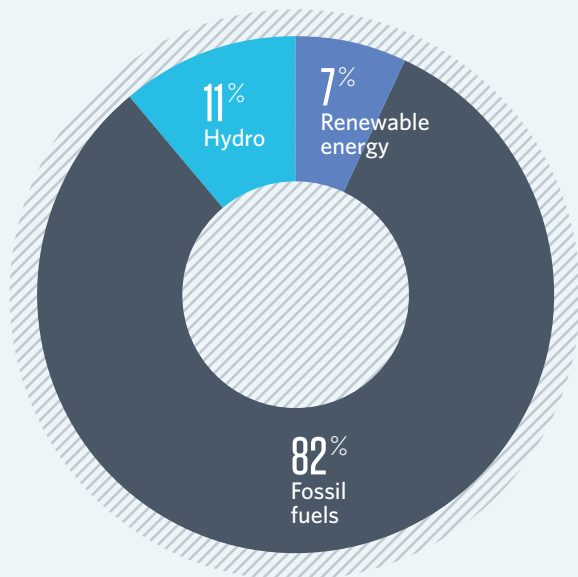
With 800 MW of installed capacity, Thailand is Asia's fourth-largest market for installed solar photovoltaics after China, Japan, and India. A system of feed-in tariffs encourages the development of utility-scale solar projects. Most recently, the government designed incentives to spur deployment of small-scale solar. Thailand has also employed import duty exemptions to boost clean energy development. An estimated 500 MW of solar capacity was added in 2013 alone.

Seeking a cleaner, more secure energy future, Thailand has set 2021 targets for biomass (4.8 GW), solar (3 GW), wind (1.8 GW), and enhanced use of ethanol. The country's leading clean energy sector is biomass, with 2.1 GW online.

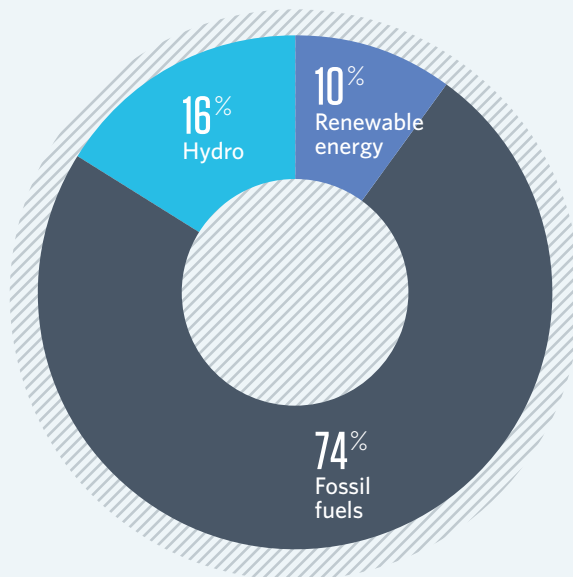
The U.S. International Trade Administration ranks Thailand as the 33rd overall clean energy market, the 16th solar market, and the 21st wind market.

Demographics		Clean energy targets	
Population	67.5 million	Renewable energy	10% of electric generation by 2021
Gross domestic product	\$387 billion	Biomass	4.8 GW by 2021
Access to electricity (2010)	100%	Solar	3 GW by 2021
		Wind	1.8 GW by 2021
Finance and investment		Clean energy policies	
Total clean energy investment, 2009-13	\$5.6 billion	Access to the grid	
Emerging market rank	1	Auction	
Share of emerging market total	20%	Feed-in tariffs	✓
Installed energy		Government loans and incentives	✓
Total installed power capacity	33 GW	Net metering	
Total clean energy capacity	3.3 GW	Renewable portfolio standard	
Clean energy share of capacity	10%	Tax credits and incentives	
5-year growth in clean energy capacity	71%	Tendering	
		Tradable permits	

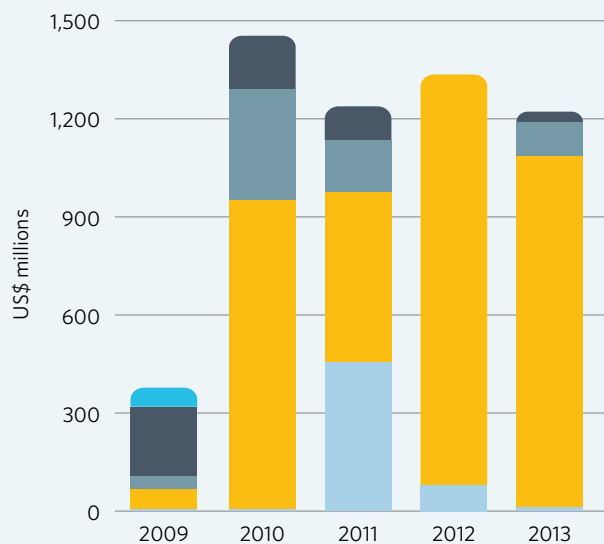
Installed Power Capacity by Technology, 2009



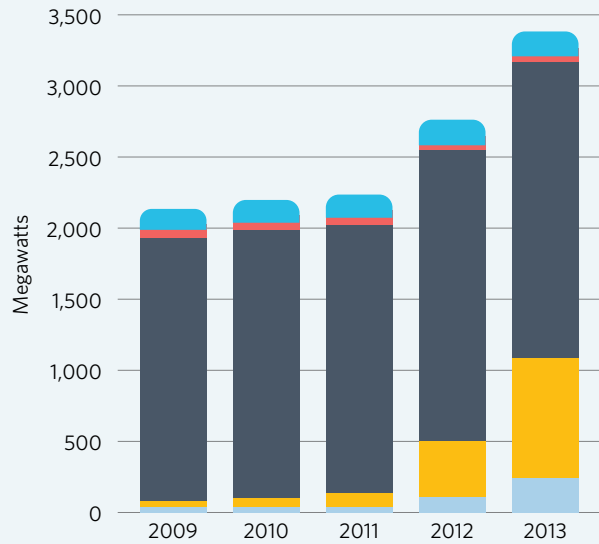
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Small hydro Geothermal Biomass Biofuels Solar Wind

Source: Bloomberg New Energy Finance

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Ukraine

Clean energy investment totaled \$3.3 billion in Ukraine from 2009 to 2013. The solar sector accounted for almost 60 percent of that figure, with \$1.9 billion, the third most among emerging markets. Wind attracted another \$1.2 billion, also third in the emerging markets. Less than \$100 million was invested in each other sector.

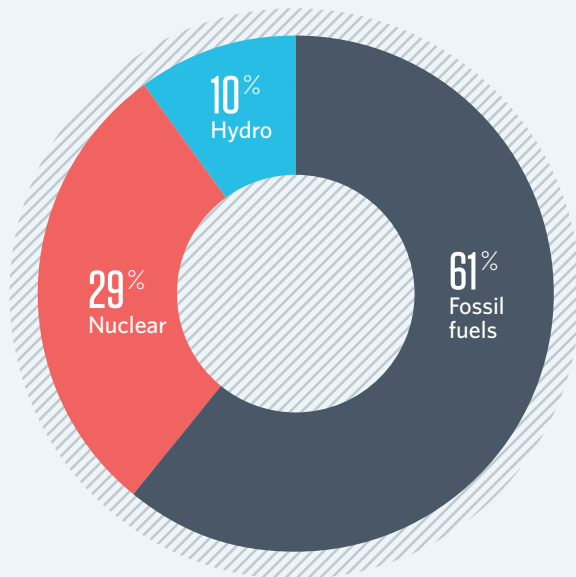
Ukraine's clean energy deployment and investment increased significantly in response to adoption of a supportive feed-in tariff program. Established in 2009, the Green Tariff program was novel in that, in addition to setting fixed prices at which clean energy could be sold, it prevented currency fluctuations. The initiative was tied to a government goal of obtaining 12 percent of electricity from renewable sources by 2020.

Ukraine added more than 800 MW of clean energy capacity between 2011 and 2013, although clean sources remain a small portion of the overall energy mix. The country installed 475 MW of wind—the most of any emerging market country over the 2009-13 period—and 780 MW of solar.

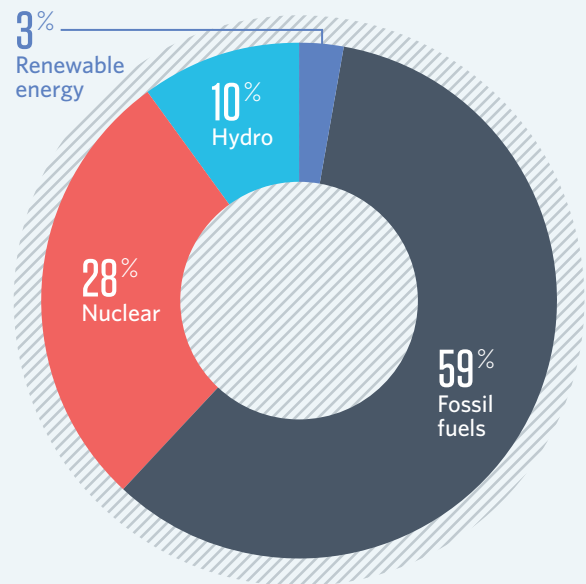
The U.S. International Trade Administration ranks Ukraine as the 43rd overall market for clean energy exports and 17th for solar energy technologies. However, prolonged political crisis in Ukraine has ceased most clean energy investment activity since the end of 2013.

Demographics		Clean energy targets	
Population	44 million	Renewable energy	12% of energy use by 2020
Gross domestic product	\$177 billion	Clean energy policies	
Access to electricity (2010)	100%	Access to the grid	
Finance and investment		Auction	
Total clean energy investment, 2009-13	\$3.3 billion	Feed-in tariffs	✓
Emerging market rank	3	Government loans and incentives	✓
Share of emerging market total	12%	Net metering	✓
Installed energy		Renewable portfolio standard	
Total installed power capacity	48.6 GW	Tax credits and incentives	✓
Total clean energy capacity	1.3 GW	Tendering	
Clean energy share of capacity	2.7%	Tradable permits	
5-year growth in clean energy capacity	6,800%		

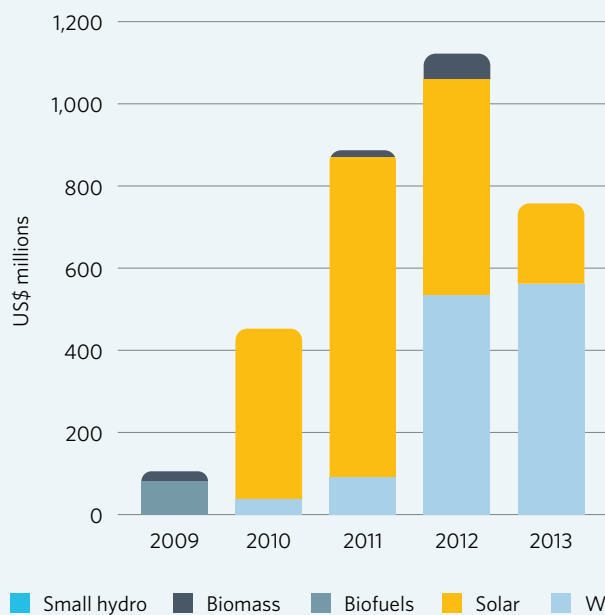
Installed Power Capacity by Technology, 2009



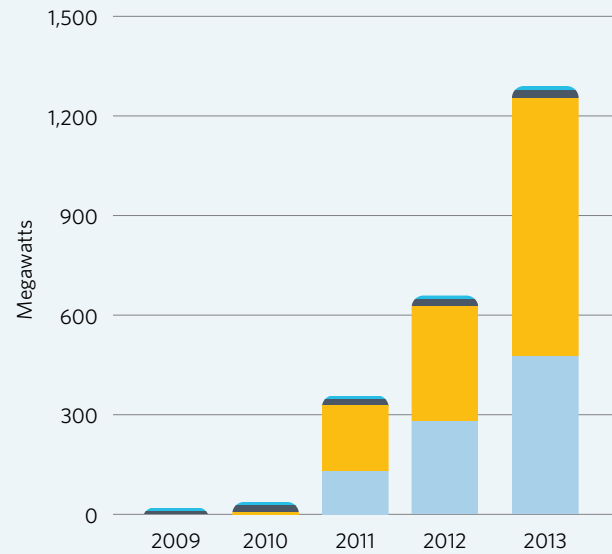
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13



Source: Bloomberg New Energy Finance

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Vietnam

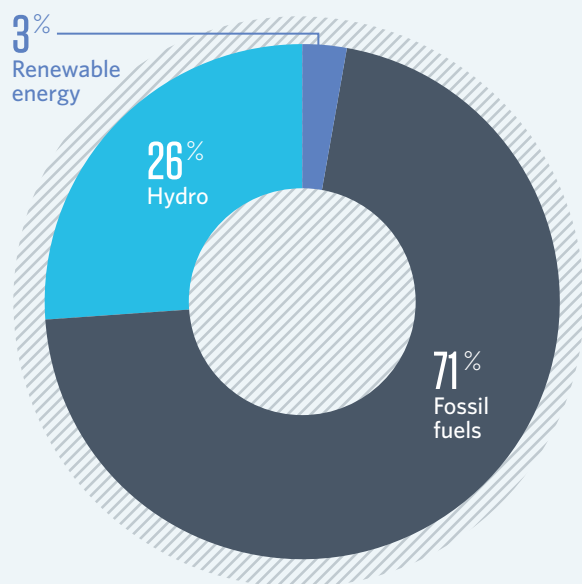
Vietnam attracted \$1.9 billion in clean energy investment from 2009 to 2013. The country was the leading emerging market for small hydro investment and installation, garnering \$1.2 billion, or 60 percent of the total, and adding 456 MW of capacity. The wind sector received \$420 million, and another \$287 million went toward biofuels.

Vietnam initiated a portfolio of clean energy policies beginning in 2008, which resulted in a sharp spike in installations from 2009 to 2012. The country set a goal of obtaining 5 percent of electricity production from renewable energy sources by 2020, compared with 3.5 percent in 2010. Small hydro has been a priority in recent years, with many projects in the 20-MW range.

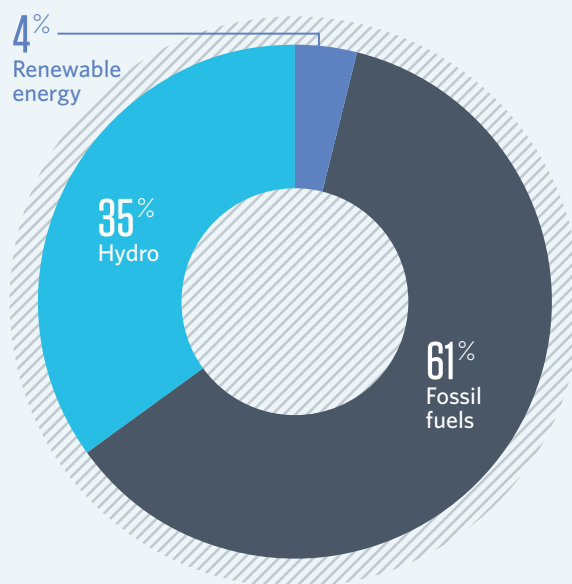
The U.S. International Trade Administration ranks Vietnam as the 28th overall clean energy market and the ninth wind energy market.

Demographics		Clean energy targets	
Population	93 million	Renewable energy	5% share of electric generation by 2020
Gross domestic product	\$171 billion	Wind	1 GW by 2020
Access to electricity (2010)	96%	Clean energy policies	
Finance and investment		Access to the grid	
Total clean energy investment, 2009-13	\$1.9 billion	Auction	
Emerging market rank	8	Feed-in tariffs	✓
Share of emerging market total	7%	Government loans and incentives	✓
Installed energy		Net metering	
Total installed power capacity	28.2 GW	Renewable portfolio standard	
Total clean energy capacity	1 GW	Tax credits and incentives	
Clean energy share of capacity	3.7%	Tendering	
5-year growth in clean energy capacity	86%	Tradable permits	✓

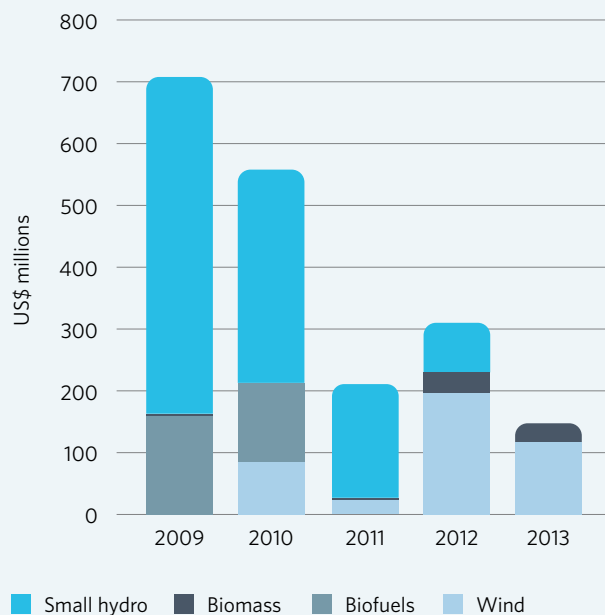
Installed Power Capacity by Technology, 2009



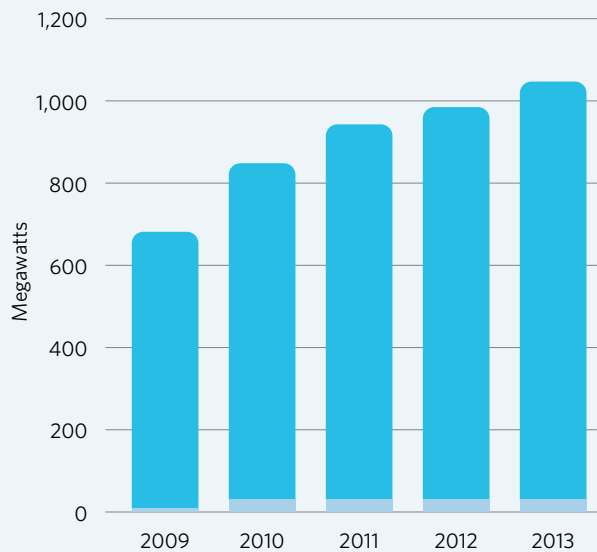
Installed Power Capacity by Technology, 2013



Clean Energy Investment by Technology, 2009-13



Total Installed Clean Energy Capacity, 2009-13

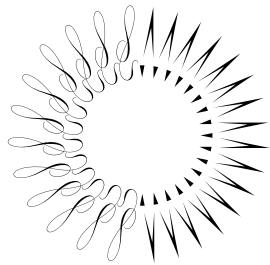


Source: Bloomberg New Energy Finance

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Endnotes

- 1 The Group of 20 was established in 1999 to bring together leading industrialized and developing economies to discuss key global economic issues. The G-20 is made up of the finance ministers and central bank governors representing the European Union and 19 countries: Argentina, Australia, Brazil, Canada, China, France, Germany, India, Indonesia, Italy, Japan, Mexico, Russia, Saudi Arabia, South Africa, South Korea, Turkey, the United Kingdom, and the United States.
- 2 The Organization for Economic Cooperation and Development comprises 34 advanced economies that work together to promote shared economic and social progress. A list of members can be found at <http://www.oecd.org/about/membersandpartners>.
- 3 Ibid.



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