RENEWABLES
GLOBAL STATUS REPORT

2009 UPDATE










REN21 Renewable Energy Policy Network for the 21st Century

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REN21 convenes international multi-stakeholder leadership to enable a rapid global transition to renewable energy. It promotes appropriate policies that increase the wise use of renewable energies in developing and industrialized economies.

Open to a wide variety of dedicated stakeholders, REN21 connects governments, international institutions, nongovernmental organizations, industry associations, and other partnerships and initiatives. REN21 leverages their successes and strengthens their influence for the rapid expansion of renewable energy worldwide.

REN21 Steering Committee

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FOREWORD

This "Update" edition of the Renewables Global Status Report is the fourth in a series launched in 2005. It provides an integrated picture of the global renewable energy situation, while coming in the midst of an historic and global economic crisis.

Although the future is unclear, there is much in the report for optimism. Indeed, the modern renewable energy industry has been hailed by most analysts as a "guaranteed-growth" sector, and even "crisis-proof," due to the global trends and drivers underlying its formidable expansion during the past decade. Policymakers have reacted to rising concerns about climate change and energy security by creating more favorable policy and economic frameworks, while capital markets have provided ample finance for development and deployment. The recent growth of the sector has surpassed all predictions, even those made by the industry itself. But we must remember that we still remain far from the political pledge made in 2002 at the World Summit on Sustainable Development (WSSD) to substantially increase the share of renewables in the global energy mix.

Many in the renewable energy sector remain anxious about the impacts of the financial crisis and how financial constraints may affect their flourishing sector. Will environmental and energy-security goals take second place to short-term economic concerns? Will clean energy be regarded as a luxury option only during periods of thriving economies?

Without a doubt, the renewable energy sector has felt the impact of the current economic crisis, but growth continues, albeit at a slower pace. This report shows that the fundamental transition of the world's energy markets is continuing. The report also shows that renewable energy expansion is policy driven, and stable and predictable government strategies will be key to helping the sector ride out the current financial downturn and emerge strongly as a critical component of a long-term, stable, low-carbon global economy.

The Washington International Renewable Energy Conference (WIREC) in March 2008 helped to publicize the opportunities provided by the renewable energy sector. The Washington event was the third high-level conference in a series launched in Bonn, Germany, in 2004. Like the Bonn conference, the Washington conference produced an impressive Action Program, including 145 pledges made by governments from around the world and stakeholders from the private sector and civil society. The Renewable Energy Policy Network, REN21, supports this conference series and manages the Action Programs to advance renewable energy policy in developed and developing economies.

This report is made possible with the financial support of the German government, which is much appreciated. I would also like to thank Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ) for administration; the members of the REN21 Steering Committee for their guidance; the REN21 Secretariat, especially Philippe Lempp, for oversight and production; all of the researchers and correspondents and reviewers for their contributions these past five years; and the report's lead authors, Eric Martinot (2005–09) and Janet Sawin (2009), for the tremendous effort of putting it all together. REN21 is proud to present the *Renewables Global Status Report 2009 Update* to the international community and welcomes comments and feedback.

Mohamed El-Ashry
Chairman, REN21

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EXECUTIVE SUMMARY

Since 2004, when the *Renewables Global Status Report* was first launched, many indicators of renewable energy have shown dramatic gains. Annual renewable energy investment has increased fourfold to reach $120 billion in 2008. In the four years from end-2004 to end-2008, solar photovoltaic (PV) capacity increased sixfold to more than 16 gigawatts (GW), wind power capacity increased 250 percent to 121 GW, and total power capacity from new renewables increased 75 percent to 280 GW, including significant gains in small hydro, geothermal, and biomass power generation. During the same period, solar heating capacity doubled to 145 gigawatts-thermal (GWth), while biodiesel production increased sixfold to 12 billion liters per year and ethanol production doubled to 67 billion liters per year.

Annual percentage gains for 2008 were even more dramatic. Wind power grew by 29 percent and grid-tied solar PV by 70 percent. The capacity of utility-scale solar PV plants (larger than 200 kilowatts) tripled during 2008, to 3 GW. Solar hot water grew by 15 percent, and annual ethanol and biodiesel production both grew by 34 percent. Heat and power from biomass and geothermal sources continued to grow, and small hydro increased by about 8 percent.

Many leadership changes and milestones in renewable energy markets and policy took place in 2008. The United States became the leader in new capacity investment with $24 billion invested, or 20 percent of global total investment. The United States also led in added and total wind power capacity, surpassing long-time wind power leader Germany. Spain added 2.6 GW of solar PV, representing a full half of global grid-tied installations and a fivefold increase over Spain's 2007 additions. China doubled its wind power capacity for the fifth year in a row, moving into fourth place worldwide. Another significant milestone was that for the first time, both the United States and the European Union added more power capacity from renewables than from conventional sources (including gas, coal, oil, and nuclear).

Renewable energy industries boomed during most of 2008. Global solar PV production increased by 90 percent to 6.9 GW in 2008. China usurped Japan to become the new world leader in PV cell production and also experienced huge growth in its wind power industry, with many new companies producing wind turbines and components. Globally, the wind industry continued to push turbine sizes higher, with models of 3 MW or larger becoming more widespread. The concentrating solar power (CSP) industry saw many entrants and new manufacturing facilities. The ethanol and biodiesel industries similarly expanded, particularly in North America and Latin America, and the cellulosic ethanol industry was in the process of booming, with 300 million liters per year of capacity under construction.

Although the clean energy sector initially weathered the financial crisis in late 2008 better than many other sectors, renewable investment did experience a downturn after September 2008. However, projects continued to progress and many economic stimulus bills included components for supporting renewable energy. At the same time, development assistance for renewables in developing countries expanded greatly, reaching about $2 billion in 2008.

By early 2009, policy targets existed in at least 73 countries, and at least 64 countries had policies to promote renewable power generation, including 45 countries and 18 states/provinces/territories with feed-in tariffs (many of these recently updated). The number of ountries/states/provinces with renewable portfolio standards increased to 49. Policy targets for renewable energy were added, supplemented, revised, or clarified in a large number of countries in 2008.

Many forms of policy support for renewables were added, supplemented, or extended in a number of countries during 2008. For example, new solar PV subsidy programs were adopted in Australia, China, Japan, Luxembourg, the Netherlands, and the United States; new laws and policy provisions for renewables appeared in developing countries, including Brazil, Chile, Egypt, Mexico, the Philippines, South Africa, Syria, and Uganda; new mandates for solar hot water and other renewable heating appeared in Cape Town (South Africa), Baden-Württemberg (Germany), Hawaii, Norway, and Poland; new biofuels blending mandates or targets appeared in at least 11 countries, including a new 20 percent target in India; and the number of green power consumers grew to more than 5 million households and businesses worldwide. City and local government policies were a growing segment of the policy landscape, with several hundred cities and local governments around the world actively planning or implementing renewable energy policies and planning frameworks linked to carbon dioxide emissions reduction.

SELECTED INDICATORS AND TOP FIVE COUNTRIES

SELECTED INDICATORS	2006	2007	2008
Investment in new renewable capacity (annual)[1]	63	104	120 billion USD
Renewables power capacity (existing, excl. large hydro)	207	240	280 GW
Renewables power capacity (existing, incl. large hydro)	1,020	1,070	1,140 GW
Wind power capacity (existing)	74	94	121 GW
Grid-connected solar PV capacity (existing)	5.1	7.5	13 GW
Solar PV production (annual)	2.5	3.7	6.9 GW
Solar hot water capacity (existing)	105	126	145 GWth
Ethanol production (annual)	39	50	67 billion liters
Biodiesel production (annual)	6	9	12 billion liters
Countries with policy targets		66	73
States/provinces/countries with feed-in policies[2]		49	63
States/provinces/countries with RPS policies		44	49
States/provinces/countries with biofuels mandates		53	55

TOP FIVE COUNTRIES	#1	#2	#3	#4	#5
Annual amounts for 2008					
New capacity investment[1]	United States	Spain	China	Germany	Brazil
Wind power added	United States	China	India	Germany	Spain
Solar PV added (grid-connected)[3]	Spain	Germany	United States South Korea Japan Italy		
Solar hot water/heat added[4]	China	Turkey	Germany	Brazil	France
Ethanol production	United States	Brazil	China	France	Canada
Biodiesel production	Germany	United States	France	Argentina	Brazil
Existing capacity as of end-2008					
Renewables power capacity	China	United States	Germany	Spain	India
Small hydro	China	Japan	United States	Italy	Brazil
Wind power	United States	Germany	Spain	China	India
Biomass power	United States	Brazil	Philippines	Germany Sweden Finland	
Geothermal power	United States	Philippines	Indonesia	Mexico	Italy
Solar PV (grid-connected)	Germany	Spain	Japan	United States	South Korea
Solar hot water/heat[4]	China	Turkey	Germany	Japan	Israel

Notes: [1]Investment analysis methods changed with this report, so data series are not compatible with prior-year reports; see Endnote 13. [2]Feed-in policies total for 2008 also includes early 2009. [3]Conflicting estimates for solar PV added in 2008 in South Korea and Italy as of press time make it difficult to definitively rank countries beyond Spain and Germany, as the next four countries are all in the range of 200–300 MW added; see notes for Table R3. [4]Solar hot water/heating numbers are for 2007. Many figures in the above table and throughout the report are rounded to two significant digits, so some totals may not exactly reflect underlying data due to rounding.

NOTE ABOUT REPORT COVERAGE

This Update edition covers major changes in renewables worldwide between late 2007 and early 2009. It is intended to show recent progress and trends and to provide updated 2008 indicators. It is designed to supplement the *Renewables 2007 Global Status Report*, published in March 2008. More complete background, explanatory notes, caveats, and status information is contained in the original 2007 report, available at www.ren21.net.

1. GLOBAL MARKET OVERVIEW

Renewable energy markets grew robustly in 2008. Among new renewables (excluding large hydropower), wind power was the largest addition to renewable energy capacity. Existing wind power capacity grew by 29 percent in 2008 to reach 121 gigawatts (GW), more than double the 48 GW that existed in 2004. The 2008 increase was led by high growth in the strongest markets of the United States (8.4 GW added), China (6.3 GW), India (1.8 GW), and Germany (1.7 GW). (See Figures 1 and 2, and Table R2.)[1]

Figure 1.
Wind Power, Existing World Capacity, 1996–2008

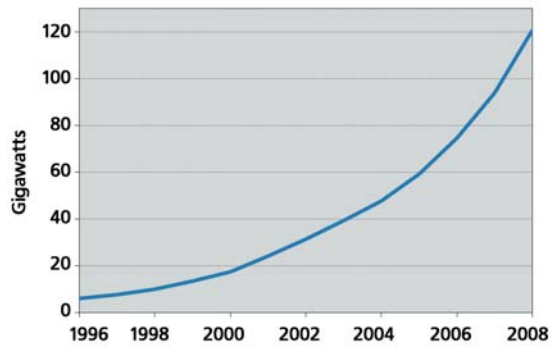
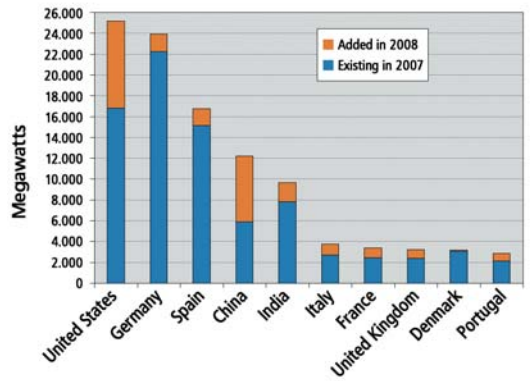


Figure 2.
Wind Power Capacity, Top Ten Countries, 2008



Many milestones were reached in 2008. The United States overtook long-time wind power leader Germany, ending the year with 25 GW compared to Germany's 24 GW. China's total wind power doubled for the fifth year in a row, ending the year above 12 GW and breaching China's 2010 development target of 10 GW two years early. More than 80 countries around the world had commercial wind power installations by 2008, with Mongolia and Pakistan being two of the most recent entrants to this group. Three sub-Saharan African countries had commercial wind power installations, but projects were under development in others, including Ethiopia, Kenya, and Tanzania. Existing offshore wind capacity reached nearly 1.5 GW in 2008, virtually all of it in Europe, with 200 megawatts (MW) added in 2007 and 360 MW added in 2008. The United Kingdom became the offshore wind power leader in 2008.

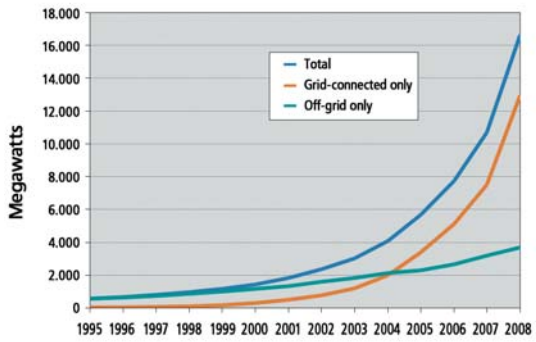
Small hydropower increased to an estimated 85 GW worldwide. Most of the small hydro is in China, where the boom in small hydro has continued with 4–6 GW added annually during 2004–08. Small hydro and micro-hydro development has also continued in several African and Asian countries. Large hydropower increased by an estimated 25–30 gigawatts in 2008, significantly more than in previous years, led by China (12–15 GW added) and India (more than 5 GW added).[2]

Biomass power generation (and cogeneration) continued to increase at both large and small scales, with an estimated 2 GW of power capacity added in 2008, bringing existing biomass power capacity to about 52 GW. Biomass power generation continued to grow in several European Union (EU) countries during 2007/2008, including Finland, France, Germany, Italy, Poland, Sweden, and the United Kingdom. China continued to increase power generation from industrial-scale biogas (i.e., at livestock farms) and from agricultural residues, mainly straw. The sugar industries in many developing countries continued to bring new bagasse power plants online, including leaders Brazil and the Philippines, and others such as Argentina, Columbia, India, Mexico, Nicaragua, Thailand, and Uruguay.[3]

Grid-connected solar photovoltaic (PV) continued to be the fastest growing power generation technology, with a 70-percent increase in existing capacity to 13 GW in 2008. This represents a sixfold increase in global capacity since 2004. (See Figure 3 and Table R3.) Annual installations of grid-tied solar PV reached an estimated 5.4 GW in 2008. Spain became the clear market leader, with 2.6 GW of new capacity installed, representing half of global installations and a five-fold increase over the 550 MW added in Spain in 2007. Spain's unprecedented surge surpassed former PV leader Germany, which installed 1.5 GW in 2008. Other leading markets in 2008 were the United States (310 MW added), South Korea (200–270 MW), Japan (240 MW), and Italy (200–300 MW). Markets in Australia, Canada, China, France, and India also continued to grow. The beginnings of gro-

wing grid-tied solar PV markets emerged in several countries in 2007/2008, notably China. Including off-grid applications, total PV existing worldwide in 2008 increased to more than 16 GW.[4]

Figure 3.
Solar PV, Existing World Capacity, 1995–2008



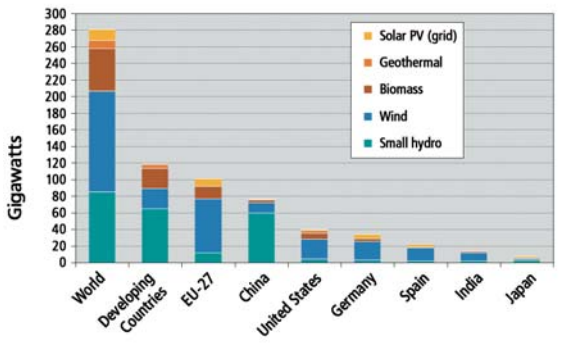
Solar PV markets showed three clear trends in 2008. The first was the growing attention to building-integrated PV (BIPV), which is a small but fast-growing segment of some markets, with more than 25 MW installed in Europe. Second, thin-film solar PV technologies became a larger share of total installations. And third, utility-scale solar PV power plants (defined as larger than 200 kilowatts, kW) emerged in large numbers in 2008. By the end of 2008, an estimated 1,800 such plants existed worldwide, up from 1,000 at the end of 2007. Altogether, these plants totaled over 3 GW, a tripling of existing capacity from 2007. The majority of utility-scale plants added in 2008 were installed in Spain (over 1.9 GW added), with others in the Czech Republic, France, Germany, Italy, Korea, and Portugal. The Spanish 60-MW Olmedilla de Alarcon plant, completed in 2008, became the largest solar PV plant in the world. New utility-scale plants are planned and under development in many countries of Europe and throughout the world, including China, India, Japan, and the United States.[5]

Geothermal power capacity reached over 10 GW in 2008. The United States remains the world development leader, with more than 120 projects under development in early 2009, representing at least 5 GW. Other countries with significant recent growth in geothermal include Australia, El Salvador, Guatemala, Iceland, Indonesia, Kenya, Mexico, Nicaragua, Papua New Guinea, and Turkey. Geothermal development was under way in over 40 countries, with at least 3 GW in the pipeline beyond the United States.[6]

Two new concentrating solar (thermal) power plants (CSP) came online in 2008—the 50 MW Andasol-1 plant in Spain and a 5 MW demonstration plant in California—following three new plants during 2006/2007. A number of additional projects were due to come online in 2009, including two more 50 MW plants and 20 MW of CSP integrated with a 450 MW natural-gas combined-cycle plant in Morocco (which would be the first operational plant of this type). The pipeline of projects under development or construction increased dramatically during 2008, to more than 8 GW by some estimates, with over 6 GW under development in the United States alone. New projects are under contract in Arizona, California, Florida, Nevada, and New Mexico in the United States and under development in Abu Dhabi, Algeria, Egypt, Israel, Italy, Portugal, Spain, and Morocco. A growing number of these future CSP plants will include thermal storage to allow operation into the evening hours. For example, the Andasol-1 plant in Spain has more than seven hours of full-load thermal storage capability, and a 280 MW plant is planned in Arizona with six hours storage.[7]

Overall, renewable power capacity expanded to 280 GW in 2008, a 75-percent increase from 160 GW in 2004, excluding large hydropower. (See Figure 4 and Table R4.) The top six countries were China (76 GW), the United States (40 GW), Germany (34 GW), Spain (22 GW), India (13 GW), and Japan (8 GW). The capacity in developing countries grew to 119 GW, or 43 percent of the total, with China (small hydro and wind) and India (wind) leading the increase. A significant milestone was reached in 2008 when added power capacity from renewables in both the United States and the European Union exceeded added power capacity from conventional power (including gas, coal, oil, and nuclear). That is, renewables represented more than 50 percent of total added capacity. (Including large hydropower, global renewable power capacity reached an estimated 1,140 GW in 2008.)[8]

Figure 4.
Renewable Power Capacities, Developing World, EU and Top Six Countries, 2008



Note: Excludes large hydropower

Renewable heating markets continued to grow as well. Existing solar hot water and heating capacity increased by 15 percent in 2008 to reach an estimated 145 gigawatts-thermal (GWth), or double the capacity in 2004. (All figures exclude unglazed swimming pool heating.) China installed three-quarters of global added capacity (14 GWth) and remained the world leader, with more than 70 percent of existing global capacity. (See Figures 5 and 6 and Table R5.) Solar hot water in Germany set record growth in 2008, with over 200,000 systems installed for an increase of 1.5 GWth in capacity. Spain also saw rapid growth, and the rest of Europe besides Germany added about 0.5 GWth of new capacity. Among developing countries, Brazil, India, Mexico, Morocco, Tunisia, and others saw an acceleration of solar hot water installations.[9]

Figure 5.
Share of Solar Hot Water/Heating Capacity Existing, Top 10 Countries, 2007

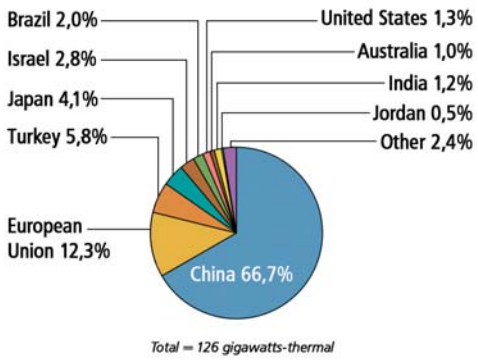
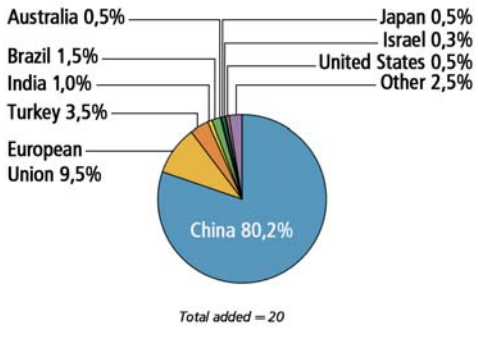


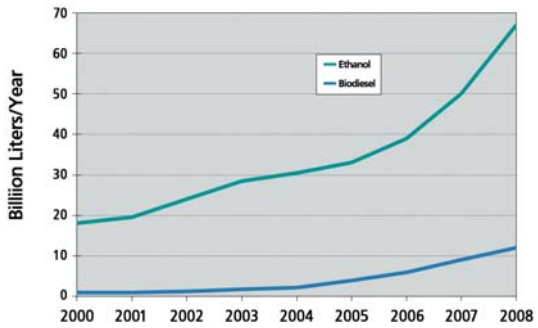
Figure 6.
Share of Solar Hot Water/Heating Capacity Added, Top 10 Countries, 2007



Geothermal (ground source) heat pumps accounted for an estimated 30 GWth of installed capacity by the end of 2008, with other direct uses of geothermal heat (i.e., for space and greenhouse heating, agricultural drying, industrial, and other uses) reaching an estimated 15 GWth. At least 76 countries use direct geothermal energy in some form.[10]

Fuel ethanol production increased by 34 percent in 2008 to 67 billion liters. (See Figure 7 and Table R6.) Thus, global fuel ethanol production by 2008 had more than doubled from 30 billion liters in 2004. Fairly stagnant for a number of years, fuel ethanol production in Brazil ramped up dramatically, increasing from 18 billion liters in 2006 to 27 billion liters in 2008. And for the first time ever, more than half of Brazil's non-diesel vehicle fuel consumption came from ethanol in 2008. Notwithstanding Brazil's achievement, the United States remained the leading ethanol producer, with 34 billion liters produced in 2008. Other countries producing fuel ethanol include Australia, Canada, China, Colombia, Costa Rica, Cuba, the Dominican Republic, France, Germany, India, Jamaica, Malawi, Poland, South Africa, Spain, Sweden, Thailand, and Zambia.[11]

Figure 7.
Ethanol and Biodiesel Production, 2000–2008

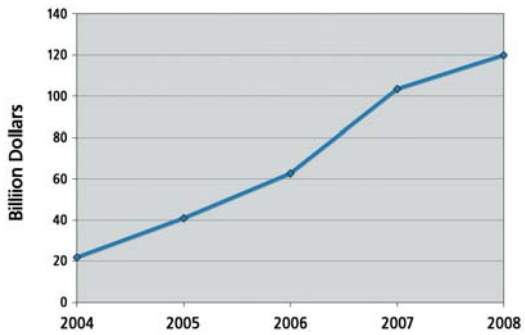


Biodiesel growth rates have been even more dramatic than ethanol, although absolute production is still much less than ethanol. Biodiesel production increased sixfold from 2 billion liters in 2004 to at least 12 billion liters in 2008. (See Figure 7 and Table R6.) The EU is responsible for about two-thirds of world biodiesel production, with Germany, France, Italy, and Spain being the top EU producers. By the end of 2008, EU biodiesel production capacity reached 16 billion liters per year. Outside of Europe, top biodiesel producers include the United States, Argentina, Brazil, and Thailand.[12]

2. INVESTMENT FLOWS

An estimated $120 billion was invested in renewable energy worldwide in 2008, including new capacity (asset finance and projects) and biofuels refineries.[a] (See Figure 8.) This is double the equivalent 2006 investment figure of $63 billion. Almost all of the increase was due to greater investment in wind power, solar PV, and biofuels. Approximate technology shares of 2008 investment were wind power (42 percent), solar PV (32 percent), biofuels (13 percent), biomass and geothermal power and heat (6 percent), solar hot water (6 percent), and small hydropower (5 percent). An additional $40–45 billion was invested in large hydropower.[13]

Figure 8.
Global Investment in Renewable Energy, 2004–2008



The United States became the investment leader in 2008 due to record wind power installations and ethanol investments, moving ahead of long-time investment leader Germany. About $24 billion in new investment took place in the United States, or 20 percent of total global investment. Spain, China, and Germany were not far behind (in that order), all in the range of $15–19 billion. Brazil was fifth, at $5 billion, due to large investments in biofuels.

In addition to the $120 billion in renewable energy investment, the solar PV and wind industries made substantial capital investments in new manufacturing plant and equipment in 2008, and total global research and development spending likely exceeded $15 billion. Further, innovation and expansion was boosted by continuing large flows of private equity investment and venture capital, at least before the late-2008 market crash. These equity and venture flows grew to $13.5 billion in 2008, up from $9.8 billion in 2007. An emerging significant component of venture capital investment went to cellulosic ethanol, estimated at more than $350 million in 2008.

A large number of banks continued to provide loans for renewable energy projects in 2008, although the degree to which lending tapered off in late 2008 and early 2009 was not yet known. Perhaps the largest single lender for renewables in 2008 was the European Investment Bank, which provided more than €2 billion ($2.6 billion) for renewable energy projects in the EU and worldwide.[b]

Development assistance for renewables investments in developing countries has expanded greatly in recent years and reached about $2 billion in 2008, up from $500 million in 2004. In 2008, German KfW committed €340 million ($440 million) in public budgetary funds and private market funds (excluding large hydropower). KfW also committed €405 million ($530 million) as part of its "Special Facility for Renewable Energies and Energy Efficiency." The World Bank Group committed $280 million (excluding Global Environment Facility funds and carbon finance), plus $1 billion for large hydropower. The Asian Development Bank and the Inter-American Development Bank both committed about $200 million. The Global Environment Facility has committed an average of around $100 million per year in recent years. The Netherlands committed €166 million ($230 million). Other official development assistance (ODA) figures from a variety of bilateral and multilateral development agencies suggest additional flows to renewables on the order of $100–200 million per year.[14]

Although the clean energy sector initially weathered the financial crisis in late 2008 better than many other sectors, renewable investment did experience a downturn after September 2008. Total clean energy investment in the second half of 2008 was down 23 percent from the second half of 2007. Overall, renewables investments did not escape the general flight from risk and from growth sectors; however, projects have continued to progress, particularly those supported by policies such as feed-in tariffs.

At the end of 2008 and in early 2009, in part in response to the financial crisis, a number of national governments announced plans to greatly increase public finance of renewable energy and other low-carbon or clean technologies. Many of these announcements were directed at economic stimulus and job creation, with millions of new "green jobs" targeted. The United States announced a goal of $150 billion for renewables over 10 years, Japan announced 1 trillion yen ($12.2 billion) over five years, Hungary is providing €250 million ($330 million) over seven years, South Korea launched a $36 billion package over four years,

[a] All dollar and cent figures in this report are in U.S. dollars unless otherwise noted. [b] All euro amounts in this report are converted to U.S. dollars at a $1.30 exchange rate.

and Australia was to accelerate an existing AUD$500 million ($370 million) renewable energy fund from the original six years to just 18 months. The United States also authorized $1.6 billion in tax credit bonds, an increase from $800 million in 2006, to finance renewables investments. The Netherlands announced €160 million ($200 million) per year for 15 years to support offshore wind power. Ireland included renewable energy lending provisions when it provided share capital to two of its biggest banks. China has been providing growing amounts of public finance to renewables in recent years—about $300 million equivalent for one period in 2007/2008, and at the end of 2008 it pledged $15 billion for renewable energy, much of it for wind power. Mexico's new 2008 renewable energy law established an $800 million fund, partly to finance renewable energy projects. Morocco announced a $1 billion fund for renewables and energy efficiency.

3. INDUSTRY TRENDS

Renewable energy industries boomed during most of 2008, with large increases in manufacturing capacity, diversification of manufacturing locations, and shifts in leadership. By August 2008, at least 160 publicly traded renewable energy companies worldwide had a market capitalization greater than $100 million. The number of companies in this category expanded significantly, from around 60 in 2005. The estimated total market capitalization of these companies in August 2008, prior to the late-2008 market crash, was more than $240 billion. Examples of additions to this category during 2008 included wind developers Iberdrola Renovables and EDP Renovavies, Hansen Transmission (wind turbine transmission equipment), and PV Crystallox (solar ingots and wafers).

Of course, the market capitalization of virtually all companies took a big hit in late 2008. Subsequently, many renewable energy companies closed plants, laid off workers, lowered sales forecasts, reduced production, and revised expansion plans for 2009 and beyond. At publication time it was still too early to assess the full impacts, although anecdotal evidence suggested that many companies continued to do well in early 2009.[16]

The solar PV industry continued to be one of the world's fastest growing industries. Global annual production increased nearly sixfold between 2004 and 2008, reaching 6.9 GW. Annual production in 2008 was 90 percent higher than in 2007. China usurped Japan to become the new world leader in PV cell production (1.8 GW not counting Taiwan), with Germany moving up to second place (1.3 GW), followed by Japan (1.2 GW), Taiwan (0.9 GW), and the United States (0.4 GW). Although the United States ranked fifth overall, it led the world in thin-film production (270 MW), followed by Malaysia (240 MW) and Germany (220 MW). Global thin-film production increased 120 percent in 2008, to reach 950 MW.[17]

There were major changes in company shares during 2007/2008. Q-Cells of Germany became the leading solar PV producer worldwide in 2007 and maintained that lead with 570 MW of cells produced in 2008. First Solar doubled production in 2008, to 500 MW, with expanded manufacturing in Germany and new manufacturing in Malaysia. And Suntech of China tripled cell production from 160 MW in 2006 to 500 MW in 2008, to tie for second place with First Solar. (By the end of 2008, Suntech claimed to have reached 1 GW production capacity in both modules and cells, the highest cell capacity of any PV company.) Former world leader Sharp of Japan fell to fourth place, with 470 MW of cells produced in 2008.[18]

The global PV industry ended 2008 with over 8 GW of cell manufacturing capacity, including 1 GW of thin-film capacity. And during the year, the solar PV industry announced additional major production capacity expansions, many of them for thin-film technology. For example, Masdar PV announced $2 billion of investments to add 210 MW of thin-film production capacity. And there were over 200 companies producing thin-film modules or planning to do so. However, many of these plans were in question after the 2008 market crash, and some cancellations were subsequently announced. For example, Suntech cancelled plans to increase production capacity (not just thin-film) by 0.4 GW during 2009. BP and Shell have also announced plant closures.[19]

India emerged in 2008 as an aspiring producer of solar PV. Both national and state governments announced new policies to support solar PV manufacturing in special economic zones, including capital investment subsidies of 20 percent. These policies led to $18 billion in new solar PV manufacturing investment plans or proposals by a number of companies.[20]

In the wind power industry, China experienced the greatest changes in 2008, with several new companies producing turbines and many new component manufacturers. The industry appeared poised to start exporting turbines and had achieved a high level of domestic sourcing for most components. By the end of 2008, at least 15 Chinese companies were commercially producing turbines and several dozen more were producing components. (The industry reportedly grew to more than 70 manufacturing companies.) Turbine sizes of 1.5 MW and 2 MW became common. Leading producers were Goldwind, Dongfang, and Sinovel. China also increased production of small-scale wind turbines, to about 80,000 turbines (80 MW) in 2008. Through all these developments, the Chinese wind industry appeared entirely unaffected by the global financial crisis, according to industry observers, and some expected manufacturing capacity to approach 20 GW per year by 2010.[21]

New wind turbine manufacturing facilities opened in several other countries during 2008, notably in the United States, where the share of domestically made components rose from 30 percent in 2005 to 50 percent in 2007. During 2008, 27 wind turbine and component manufacturing facilities came online or were expanded, and plans for an additional 30 facilities were announced. And companies in at least two other developing countries, Egypt and Turkey, started to manufacture megawatt-scale wind turbines for the first time. In 2008, the top 10 wind turbine manufacturers globally were (in order of production): Vestas (Denmark), GE Wind (USA), Gamesa (Spain), Enercon (Germany), Suzlon (India), Siemens (Denmark), Sinovel (China), Acciona (Spain), Goldwind (China), and Nordex (Germany). These top 10 were responsible for 85 percent of global production in 2008. The industry continued to push turbine sizes upward, with turbines models of 3 MW or larger now in commercial use (made by Enercon, Repower, Siemens, Vestas, and WinWind).[22]

The concentrating solar (thermal) power (CSP) industry saw many new entrants and new manufacturing facilities in 2008. Active project developers grew to include Ausra, Bright Source Energy, eSolar, FPL Energy, Infinia, Sopergy, and Stirling Energy Systems in the United States; Abengoa Solar, Acciona, Iberdrola Renovables, and Sener in Spain; and Solar Millennium in Germany. Ausra also opened a manufacturing facility in the U.S. state of Nevada that will begin to produce 700 MW per year of CSP components by mid-2009. Schott Solar of Germany opened a manufacturing plant in Spain and is constructing a similar plant in New Mexico to make receiver tubes. Rio Glass Solar opened a manufacturing plant in Spain for trough mirrors, and Flabeg of Germany announced plans to build a parabolic mirror factory in the United States.[23]

The ethanol and biodiesel industries expanded in North America and Latin America, and to a lesser extent in Europe. During 2008, 31 new ethanol refineries came online in the United States, bringing total production capacity to 40 billion liters per year, with additional capacity of 8 billion liters per year under construction. (There were also about 1,900 E85 ethanol refueling stations in the United States, mostly in the Midwest.) In Brazil, the biofuels industries expanded dramatically during 2007/2008, with over 400 ethanol mills and 60 biodiesel mills operating by the end of 2008. About 15 percent of Brazil's ethanol production was exported in 2008. Argentina became a major biodiesel producer in 2008, with 18 commercial plants in operation, all producing for export; another 16 plants were expected during 2009 to bring capacity to 1.8 billion liters per year. In Europe, more than 200 biodiesel production facilities were operating, and additional ethanol production capacity of over 3 billion liters per year was under construction.[24]

The cellulosic ethanol industry accelerated development of new commercial-scale plants in 2008. In the United States, plants totaling 12 million liters per year were operational, and additional capacity of 80 million liters per year was under construction (also reported as 26 new plants under development and construction). In Canada, capacity of 6 million liters per year was operational. In Europe, a handful of plants were operational in Germany, Spain, and Sweden, and capacity of 10 million liters per year was under construction. The largest second-generation biofuels plant in the world will come online in Delfzijl, the Netherlands, in 2009, to produce 200 million liters per year of bio-methanol. Globally, additional capacity of at least 1.5 billion liters per year was planned. Industry pioneers include Royal Nedalco (the Netherlands), Econcern (the Netherlands), Iogen (Canada), Diversa/Celunol (USA), Abengoa (Spain), and the Broin & DuPont consortium (USA).[25]

Jobs from renewable energy continued to expand rapidly during 2008, beyond the 2.4 million jobs worldwide estimated for 2006 in the *Renewables 2007 Global Status Report*. However, no new global estimate is available, although a variety of sources give country-specific job numbers.[26]

4. POLICY LANDSCAPE

Policy Targets for Renewable Energy

Policy targets for renewable energy were added, supplemented, revised, or clarified in a large number of countries in 2008. By early 2009, policy targets for renewable energy existed in at least 73 countries. This includes state/provincial-level targets in the United States and Canada, which have no national targets. In addition, an EU-wide target was enacted in 2007.[27]

In the EU, final confirmation was reached in 2008 on country-specific targets for shares of final energy consumption by 2020 (as reported in Table R7 of the *Renewables 2007 Global Status Report*). There were no changes to any of the originally proposed targets for final energy shares, except for a small change for Latvia. Some countries adopted additional or supplementary targets, such as Germany's 30 percent electricity and 14 percent heating targets by 2020. The confirmation process resulted in a number of special provisions, including a 2014 interim review and provisions related to greenhouse gases. The original transport-sector target (10 percent share of transport energy by 2020) was also retained but was modified to encompass biofuels, electric vehicles, and electric trains, with a credit multiplier of 2.5 for renewable electricity consumed by electric vehicles. Special provisions for biofuels sustainability were also adopted, including double crediting of second-generation (i.e., cellulosic) biofuels and excluding from credit any biofuels that do not save at least 35 percent of greenhouse gas emissions compared to the equivalent fossil fuel use.[28]

Many new national-level targets were set in 2008 and early 2009. Among these, Australia targeted 45 terawatt-hours (TWh) of electricity by 2020. Brazil's energy plan sought to slightly increase through 2030 its existing share of primary energy from renewables (46 percent in 2007) and its electricity share (87 percent in 2007). India increased its target to 14 GW of new renewables capacity by 2012. Japan set new targets for 14 GW of solar PV by 2020 and 53 GW by 2030. Other new capacity targets included France (4.9 GW of solar PV by 2020), Kenya (350 MW of wind and biomass power), and Indonesia (9.5 GW of geo-thermal by 2025). New electricity-share targets were Abu Dhabi (7 percent by 2020), Bangladesh (10 percent by 2020), Cape Verde (50 percent by 2020), Ireland (40 percent by 2020), Israel (10 percent by 2020), Jamaica (15 percent by 2020), Madagascar (75 percent by 2020), Nicaragua (38 percent by 2011), Russia (1.5 percent by 2010 and 4.5 percent by 2020), and Rwanda (90 percent by 2012).

Sidebar 1. International Renewable Energy Agency (IRENA)

The beginning of 2009 witnessed a significant milestone in renewable energy policy and institutions. By April 2009, 78 countries had signed the statute of the International Renewable Energy Agency (IRENA). Members include most countries of the European Union and many developing countries, from Africa to Asia-Pacific to Latin America, including Argentina, Chile, Ghana, India, Morocco, the Philippines, Senegal, South Korea, and Tunisia.

IRENA will provide advice and support to governments worldwide on renewable energy policy, capacity building, and technology transfer. IRENA will also improve the flow of financing and know-how and collaborate with existing renewable energy organizations. IRENA's goal is ultimately to increase the share of renewable energy worldwide. Such a dedicated multilateral agency for renewables has been conspicuously absent from the international landscape, and IRENA's founding reflects a growing consensus among governments around the world on the need to actively support the expansion of renewable energy.

New primary-energy share targets included Albania (40 percent by 2020); Korea (6.1 percent by 2020 and 11 percent by 2030), Pakistan (10 percent by 2012), Samoa (20 percent by 2030), and Tunisia (10 percent by 2011).[29] (For existing targets, see also Tables R7 through R9 of the *Renewables 2007 Global Status Report* and a periodically updated summary table at www.ren21.net.)

The number of states and provinces in the United States and Canada with policy targets increased to 46 in 2008 (including 33 states/provinces with renewable portfolio standards and 13 with non-RPS policy goals). In 2008, in addition to three U.S. states with new policy targets based on renewable portfolio standards (see RPS policies below), new policy goals were set in Nova Scotia, South Dakota, Utah and the U.S. territory of Guam. Several other U.S. states and Canadian provinces increased targets or strengthened provisions.[30]

New targets in other sub-national jurisdictions include Chinese Taipei (Taiwan) (10 percent of electricity by 2010), Scotland (31 percent of electricity by 2011 and 50 percent by 2020), and Gujarat, India (500 MW). There are also existing targets in at least six Indian states.[31]

Although not strictly a target, China's plan to go beyond its existing goal of 30 GW of wind power by 2020 is noteworthy. China is planning new large-scale "wind power bases" in six provinces/regions that could result in 100 GW of new wind power capacity by 2020. China's 2007 RPS mandates for power generators—8 percent of capacity and 3 percent of generation by 2020—also imply an additional 100 GW of non-hydro renewables power capacity by 2020, according to one analysis.[32]

During 2007/2008, a number of countries already exceeded existing targets for 2010, including China (10 GW of wind capacity target), Germany (electricity target), Hungary (electricity target), and Spain (solar PV target).

Power Generation Promotion Policies

By early 2009, at least 64 countries had some type of policy to promote renewable power generation.[33] (See Table 2 of the *Renewables 2007 Global Status Report* for the full list of countries with existing policies.) This includes at least 45 countries and 18 states/provinces/territories around the world with feed-in tariffs. (See Table R10.) Feed-in tariffs were adopted at the national level in at least five countries for the first time in 2008/early 2009, including Kenya, the Philippines, Poland, South Africa, and Ukraine. Following its former feed-in policies in the 1990s, India also adopted new feed-in tariffs for solar PV and solar thermal power. Norway followed its 1990s feed-in tariff with a new tariff for hydro, wind, and biomass power. Several more countries were engaged in developing feed-in policies, including Egypt, Israel, Japan (at least for distributed solar PV), Nigeria, and the United Kingdom. Indeed, the flurry of policy discussions in 2008 should result in many more feed-in policies being adopted during 2009/2010.[34]

At the state/provincial level, at least 10 jurisdictions adopted new feed-in tariffs in 2008/early 2009, including at least six Indian states, Queensland in Australia, California in the United States, and Ontario in Canada. Ontario's tariffs were part of its pending Green Energy Act. A new trend in 2008 was serious consideration of feed-in tariffs by several U.S. states, in many cases to supplement existing renewable portfolio standards. California was the first state to adopt a feed-in tariff (following much more limited-scale tariffs for solar PV in three other states), although the tariff is limited to small generators of less than 1.5 MW.[35]

Several countries revised or supplemented their feed-in laws in 2008 and early 2009, including Bulgaria, France, Germany, Ireland, Portugal, the Slovak Republic, Spain, Switzerland, and Turkey. Common revisions included extending feed-in periods, modifying tariff levels, adjusting annual percentage decreases in tariffs, establishing or removing annual program capacity caps, adding eligibility for (distributed) micro-generation (including small-scale wind power), and modifying administrative procedures. Some examples: Bulgaria increased the feed-in period from 12 to 25 years for solar PV. Spain reduced tariffs for solar PV because its 2010 target was already achieved, set 10-percent annual tariffs reductions, and also instituted a 500 MW solar PV capacity cap for both 2009 and 2010. Portugal added a feed-in tariff for micro-generation (maximum capacity 5.75 kW). Germany instituted 8–10 percent annual tariff reductions for solar PV but also increased tariffs for both onshore and offshore wind power. Greece revised solar PV tariffs (stabilized through 2010/2012), eliminated an unofficial capacity cap, and instituted competitive bidding for large-scale solar PV plants greater than 10 MW. France added a new solar PV tariff for commercial buildings. Ireland increased tariffs for micro-generators and provided government grants. Switzerland instituted an entirely new feed-in tariff regime.[36]

Three U.S. states and two countries adopted renewable portfolio policies in 2008, bringing to 49 the total number of countries, states, and provinces worldwide with RPS polices. (See Table R11.) The U.S. states were Michigan (10 percent by 2015), Missouri (15 percent by 2021), and Ohio (12.5 percent by 2025). In addition, several other U.S. states increased targets and updated policies. Hawaii doubled its target to 40 percent by 2030. California supplemented its existing target of 20 percent by 2010 with a new target of 33 percent by 2020. Maryland increased its target to 20 percent by 2020, including a minimum requirement for solar PV. Other states have modified policies to allocate a portion of the RPS quota to specific forms of generation such as solar PV, or to small generators below a specific size threshold.[37]

At the national level, India added a new renewable portfolio standard for utilities, starting at 5 percent in 2010 and increasing by 1 percent per year to 15 percent in 2020. Chile also added a new RPS, also starting at 5 percent for the period 2010–14 and then increasing by 0.5 percent per year to 10 percent by 2024.

New or expanded solar PV promotion programs continued to appear around the world at the national, state/provincial, and local levels. Most significant was the opening of the grid-connected solar PV market in China with a new policy for building-integrated PV (solar panels used as architectural

components), which also applies to off-grid applications. That policy provides initial subsidies in 2009 of 20 RMB per watt ($3 per watt) for installations larger than 50 kW. (Such minimum capacity caps are unusual globally, as most other subsidy policies set maximum capacity caps.) It also specifies minimum solar cell efficiencies and gives priority to building-integrated systems and public buildings.

Some other examples of new and modified solar PV promotion policies include: Japan increased national solar PV subsidies for schools, hospitals, and railway stations from 33 percent to 50 percent, in addition to reinstating subsidies for households that had expired in 2005 (although at a lower level of about 10 percent). Japan also plans to have more than two-thirds of newly built houses equipped with solar PV by 2020. Australia, Luxembourg, and the Netherlands all enacted new solar PV subsidy programs. In the United States, Massachusetts and New Jersey adopted capital subsidies ($1.75 per watt for residential up to 10 kW and $1 per watt for non-residential up to 50 kW in New Jersey). A number of U.S. states and cities have been considering residential solar lease/loan programs, following the lead of emerging programs in Connecticut and the city of Berkeley, California. India enacted a comprehensive support program for solar PV with subsidies and loans to supplement the new national feed-in tariff for solar PV. And Mexico established a standard contract for net metering that includes commercial solar PV installations up to 30 kW.[38]

Many other countries boosted or extended various forms of policy support in 2008 and early 2009. Examples include: Portugal simplified licensing for small renewables producers. Denmark began public investment in wind farms. The province of Ontario in Canada was finalizing a "Green Energy Act" that gives priority to all forms of renewable energy, promotes community involvement, and establishes a "renewable energy czar" at the provincial level. In the United States, the federal 30 percent investment tax credit (ITC) was extended through 2016 for solar PV, solar thermal power, solar hot water, small wind, and geothermal. The $2,000 cap on residential credits was removed, and ITC eligibility was broadened to include utility companies. And the U.S. production tax credit (PTC) was extended for wind power through 2012, and for biomass, geothermal, hydropower and marine power through 2013. At the state level, net-metering policies were broadened or added, with the result that 44 U.S. states now have some type of net-metering policy. And many net-metering laws continued to increase capacity limits; for example, the province of Nova Scotia in Canada increased the capacity limit from 100 kW to 1 MW.[39]

Among developing countries, Mexico adopted a new renewable energy law that mandates utility purchases of renewables generation, sets up a project fund, and mandates a national target (to be determined). The Philippines similarly adopted a milestone renewable energy law, which mandates both renewable portfolio standards (to be developed within one year) and feed-in tariffs for wind, solar, biomass, small hydro, and ocean power. The Philippines law also provides connection priority and transmission priority for renewable generators, allows consumers to voluntarily choose to purchase renewable power from suppliers, and provides tax and import-duty incentives for investment. Brazil's national PROINFA program, begun in 2002, achieved in 2008 its goal of 3,300 MW of renewables capacity from small hydro, wind, and biomass and was initiating a second program stage to achieve 10 percent of electricity production from these sources by 2020. China changed VAT- and import-duty-related promotion mechanisms to further favor domestic wind turbine production. India provided accelerated tax depreciation along with its national feed-in tariff. Egypt's new electricity law enables independent renewable power producers and calls for feed-in tariffs. Syria's new Energy Conservation Law encourages private-sector renewable power generation. Uganda increased an off-grid solar PV capital subsidy from 14 percent to 45 percent. South Africa created a new public agency to accelerate renewables projects. And Chile's new 2008 national renewable energy development program created a market-facilitation, best-practice, and promotion center for renewables.[40]

Solar and Other Renewable Hot Water/ Heating Policies

Mandates for solar hot water/heating and other forms of renewable hot water/heating in new construction accelerated during 2008, following the example of Spain, the first country to mandate solar water heating at both national and local levels. Cape Town in South Africa finalized its mandate for most new buildings, and the South African government was considering mandates at the national level. Syria mandated building design suitable for solar hot water. New Delhi mandated solar hot water for a wide variety of new institutional, corporate, and residential buildings. In Germany, the state of Baden-Württemberg enacted the country's first renewable heating law requiring that all new buildings produce 20 percent of their water and space heating requirements with renewables; existing buildings have two years to make the transition to 10 percent. At the federal level in Germany, a new minimum requirement for both hot water and space heating supply

from renewables (including solar, biogas, biomass, and ground-source heat pumps) in new buildings entered into force at the start of 2009, and public funds for converting existing buildings were increased to €500 million ($650 million). Norway requires renewable hot water heating in public buildings greater than 500 square meters. In the United States, Hawaii will require solar hot water in all new single-family homes constructed starting in 2010.[41]

A wide variety of other policy additions and changes for renewable heating occurred during 2007/2008. Indeed, much more policy attention was paid to renewable heating than in previous years. For example: Canada adopted a 25 percent investment subsidy. Ireland started to provide grants for homes and public and commercial buildings. Luxembourg began to provide 40–50 percent subsidies for solar and geothermal heating and 25–30 percent for biomass heating. Norway established a national bioenergy target of 14 TWh by 2020. Mexico and a number of other countries developed new technical standards. Mexico also established a "green mortgage" program to finance new solar hot water installations and other water and energy conservation measures. The South African utility Eskom started a solar hot water subsidy program that provides $200–350 per household. Morocco lowered VAT on solar hot water systems and planned to enact mandates in 2009. Poland established an obligation for utilities to purchase renewable heat in addition to the electricity feed-in tariff. The United States extended a federal 30-percent tax credit that applies to solar hot water through 2016 and eliminated a $2,000 cap for residential solar hot water.[42]

Biofuels Policies

Compared to the frenzy of new biofuels policies, tax exemptions, and targets enacted in 2006/2007, the year 2008 was relatively quiet for biofuels policy (with the exception of the sustainability and other provisions adopted in the EU as part of its transportation energy target, as noted in the targets section above). Still, a number of countries adjusted price regulation, modified tax incentives, or adjusted targets, and national biofuels targets and blending mandates continued to evolve. For example, in a concession to market realities, Germany lowered the mandatory biofuels blend rate for all transport fuels from 6.25 percent to 5.25 percent for 2009. The rate will again increase to 6.25 percent for 2010–14.

All EU countries now have a biofuels target, most for 5.75 percent of transport fuels by 2010. Some of the targets are in the range of 1–3 percent, and a few are just indicative. France has the highest target: 7 percent by 2010. India approved a new target of 20 percent biofuels blending in both gasoline and diesel over 10 years, along with tax incentives for growers of biofuels crops. The initial mandate was for E5 blending in 2008 but ethanol supply issues may have delayed that mandate. Countries with new biofuels targets identified in 2008 include Australia (350 million liters by 2010), Indonesia (3 percent by 2015 and 5 percent by 2015), Japan (500 million liters by 2012), Madagascar (5 percent by 2020), and Vietnam (300 million liters by 2020). Several blending mandates were enacted or modified in 2008, including in Brazil, India, Jamaica, Korea, and Thailand. (See Table R12.)[43]

Green Power Purchasing

Green power markets grew strongly during 2007/2008 in several countries, and the number of green power consumers worldwide grew to over 5 million households and businesses. Recent data are difficult to obtain for many countries, but four countries stand out during this period. The United States had more than 850,000 green power consumers purchasing an estimated 18 TWh in 2007, up 50 percent from 12 TWh in 2006. The U.S. Environmental Protection Agency's "Green Power Partnership" grew to more than 1,000 partners who were collectively purchasing 16 TWh of green power annually by the end of 2008, almost double the 9 TWh in 2007. In Germany, more than 1 million households purchased about 2.8 TWh of green power in 2007, and more than 60,000 commercial customers purchased another 1.3 TWh. Estimates for 2008 show household purchases in Germany more than double 2007 levels, at 6.6 TWh, while commercial purchases remained at roughly 2007 levels. In Australia, almost 900,000 homes and 34,000 businesses purchased 1.8 TWh in 2008. And the number of green power customers in Switzerland increased from roughly 500,000 in 2006 (2.8 GWh purchased) to 600,000 in 2007 (4.7 GWh purchased).[44]

City and Local Government Policies

City and local government policies for renewable energy are a diverse and growing segment of the renewable energy policy landscape, with several hundred cities and other forms of local government around the world adopting goals, promotion policies, urban planning, demonstrations, and many other activities. It is impossible to capture all these activities in a few paragraphs, but some 2008 highlights are presented below. (See the *Renewables 2007 Global Status Report* for many more examples and details and a full discussion of policy types and trends.)

Some cities and local governments set ambitious new targets in 2008. For example, Los Angeles announced plans for 1.3 GW of solar power by 2020, enough to meet 10 percent of expected electricity supply, through a combination of residential and commercial programs and city-owned facilities. Tokyo is targeting 1 GW of new solar PV by 2010 and will be providing local subsidies in addition to national subsidies.[45]

A new trend in 2008 was for cities and local governments to consider feed-in policies and explore how to implement these policies. Such policies depend on whether a local government has jurisdiction to regulate the appropriate electric utilities. Examples include: In 2008, the Gainesville Regional Utility in Florida announced plans to develop a feed-in tariff for photovoltaics with a 32 cents per kilowatt-hour (kWh) payment for 20 years, although the 4 MW program cap for 2009 was reached before the program even became effective. The mayor of Los Angeles announced a solar feed-in tariff in order to develop 150 MW of solar by 2016. The California cities of Santa Monica and Palm Desert are also studying feed-in tariffs. And Canberra in Australia introduced a feed-in tariff for small-scale producers.

Cities and local governments expanded support for solar hot water, following the actions of some 70 cities in Spain in recent years to mandate solar hot water in new construction. For example, Tokyo set a new requirement that property developers assess the possibilities for solar hot water and other renewables and report their assessments to landowners. Tokyo also introduced "green heat certificates," similar to green electricity certificates, which were to be used in a municipal carbon cap-and-trade system beginning in 2010. Several cities in Brazil were working to promote solar hot water in residential and commercial buildings, including São Paulo and Porto Alegre.

Cities and local governments continued to adopt carbon dioxide emissions reduction goals. Among new initiatives in 2008, Sydney pledged to become Australia's first carbon-neutral government, obtaining 100 percent of city government energy supply (i.e., for municipal services and buildings) from renewables and pledging that all city activities, from collecting garbage to running libraries to lighting streets, will have no net carbon emissions.

Groupings of cities and local governments continued to form, expand, plan, and take collective action, sometimes through a national initiative. For example, India plans to establish 60 "solar cities" that would reduce energy demand by 10 percent with renewables and efficiency by 2012, with Nagpur and Rajkot as two of the first cities under this program. The European Commission in 2008 facilitated the creation of a "Covenant of Mayors," as a network of local governments across Europe committed to reducing carbon dioxide emissions and energy consumption beyond the EU objective of 20 percent by 2020. That network involved almost 500 local governments by April 2009. The U.S. Mayors Climate Protection Agreement grew to include over 930 mayors from all 50 states in 2008. The U.S. Department of Energy's Solar America Partnership likewise grew, doubling from 13 cities in 2007 to 25 cities in 2008. And in Japan, more than 300 municipalities continue to provide solar PV subsidies and support green power purchasing and other renewables policies through a new policy and communications platform established in 2008.[46]

Another clear trend for 2008 was that regional, national, and state/provincial policies for renewables and climate change were having an increasing effect on local government policy action and initiative. Europe is among the best examples, where EU policy and national policies have fostered local renewable energy goals and actions, particularly among a number of local governments in Austria, Finland, Germany, Sweden, and the United Kingdom.

At the international level, local governments are increasingly involved in climate change discussions and meetings associated with the United Nations Framework Convention on Climate Change—with expanded participation at COP-14 in Poznań, Poland, in December 2008 and preparations for COP-15 in Copenhagen, Denmark, in December 2009. These fora have been used to create and strengthen the groupings and initiatives of local governments mentioned above.

5. RURAL (OFF-GRID) RENEWABLE ENERGY

Progress with rural use of renewable energy is difficult to track comprehensively on a year-by-year basis—particularly traditional and modern biomass use, which continues to dominate rural energy consumption. A few trends are highlighted in this section. (See the *Renewables 2007 Global Status Report* for a more comprehensive picture of rural energy from renewables.)

One clear emerging trend in 2008 was the introduction of off-grid solar PV products that are much smaller than the traditional 20–50 watt solar PV systems. Sometimes called "pico-PV," these less-expensive systems of 1–5 watts can provide meaningful service to lower-income households, particularly when coupled with advanced technologies such as ultra-low-power white LED (light emitting diode) lamps. This market segment has seen a large number of new producers over the last three years who offer solar torches, one-piece solar lanterns, or miniature solar-home-system kits that power one or two LED lamps and often a radio or cell phone charger.

Progress on the scale of millions of households was particularly visible during 2008 for some of the donor-led rural energy development projects and programs that have been under way in recent years. For example, the 2004 Dutch/German program "Energising Development (EnDev)" established a goal of providing 5 million people with full access to modern energy through improved cooking technology and electricity access. By 2008, the program had exceeded its goal, mostly with improved biomass cookstoves, and a second phase to serve a cumulative 10 million people by 2015 was initiated. A World Bank energy-access project in Ethiopia has resulted in sales of nearly 1 million improved efficiency cookstoves; new enhanced-efficiency stove models are being tested and produced, and more than 500 stove producers have been trained in their production and commercialization.

Rural electrification policies and programs using renewable energy continued to emerge and progress. New rural electrification programs using renewable energy for off-grid or mini-grid access started in Egypt, Palestine, and Vanuatu. A Bolivian program called "Electricity for living with dignity" targets 200,000 rural homes during 2006–10, with a goal to increase the electrified rural population from 30 to 50 percent. The Peruvian Rural Electrification Plan intends to increase the served rural population from 30 percent in 2007 to 58 percent in 2011. In Brazil, the Luz Para Todos ("light for everyone") program was beginning to supply renewables to villages using vegetable oils and gasified agricultural/wood residues for power generation.

India's Remote Village Electrification Program continued to achieve steady progress. By early 2009, a cumulative total of 4,250 villages and 1,160 hamlets had been electrified using renewables. Rural applications of solar PV in India increased to more than 435,000 home lighting systems, 700,000 solar lanterns, and 7,000 solar-power water pumps. There were 637,000 solar cookers in use and 160 MW of small-scale biomass gasification systems for off-grid power generation. India recently proposed to augment cooking, lighting, and motive power with renewables in 600,000 villages by 2032, starting with 10,000 remote unelectrified villages by 2012.

Many rural energy projects incorporating solar home systems and other applications of solar PV continued to progress, and new projects were being started. For example, in 2008, two new World Bank projects in Bangladesh were approved for 1.3 million solar home systems to be installed by Grameen Shakti and IDCOL. (These projects are among the first to incorporate off-grid PV carbon finance.) The World Bank's China Renewable Energy Development project was completed in mid-2008 with solar PV systems for more than 400,000 households in northwestern provinces (11 MW total). A German KfW project in Morocco also completed in 2008 resulted in 40,000 households with solar PV. World Bank solar home system projects in Bangladesh and Sri Lanka continued, with cumulative installations by 2008 in 260,000 households in Bangladesh and 125,000 households in Sri Lanka.

REFERENCE TABLES

Table R1. Renewable Energy Added and Existing Capacities, 2008 (estimated)

	Added during 2008	Existing at end of 2008
Power generation (GW)		
Large hydropower	25–30	860
Wind power	27	121
Small hydropower	6–8	85
Biomass power	2	52
Solar PV, grid-connected	5.4	13
Geothermal power	0.4	10
Concentrating solar thermal power (CSP)	0.06	0.5
Ocean (tidal) power	~0	0.3
Hot water/heating (GWth)		
Biomass heating	n/a	~250
Solar collectors for hot water/space heating	19	145
Geothermal heating	n/a	~50
Transport fuels (billion liters/year)		
Ethanol production	17	67
Biodiesel production	3	12

Source: See Endnotes 1–12 and sources for Tables R2–R6.

Table R2. Added and Existing Wind Power, Top 10 Countries, 2008

Country	Added in 2008 (MW)	Cumulative at end of 2008 (MW)
United States	8,360	25,170
Germany	1,670	23,900
Spain	1,610	16,740
China	6,300	12,210
India	1,800	9,650
Italy	1,010	3,740
France	950	3,400
United Kingdom	840	3,240
Denmark	80	3,180
Portugal	710	2,860

Note: Figures rounded to nearest 10 MW. *Source*: GWEC 2009, WWEA 2009, and Spanish Wind Energy Association.

Table R3. Grid-Connected Solar PV, 2004–2008 (megawatts)

Country	Added 2004	Added 2005	Added 2006	Added 2007	Added 2008	Existing 2005	Existing 2006	Existing 2007	Existing 2008
Germany	600	860	900	1100	1500	1,900	2,800	3,900	5,400
Spain	12	23	100	550	2600	50	150	700	3,300
Japan	270	310	290	240	240	1,200	1,490	1,730	1,970
California	47	55	70	95	150	220	320	480	730
Other USA	10	10	30	65	100				
Other EU	10	40	50	170	400	130	180	350	750
South Korea	3	5	20	60	250	15	35	100	350
Other World	–	>20	>50	>150	>200	>30	>80	>250	>450
Total Added	900	1,300	1,500	2,400	5,400				
Cumulative						3,500	5,100	7,500	12,950

Notes: All figures are approximate and subject to revision with future data. These figures do not include estimates for the amount of off-grid PV installed annually. There is a wide disparity in estimates for added PV in several countries for the years 2006–08 in particular. PV News (Prometheus Institute) has been the main source of PV installation data since the original *Renewables 2005 Global Status Report,* but data from other sources have also been considered and incorporated. Figures for Germany exhibited wide disparity for 2006 and 2007, but estimates from different sources seem to have converged for 2008. Systèmes Solaires gives 1,100 MW for Germany in 2007, while other estimates give 1,200–1,260 MW. Estimates for South Korea in 2008 range from 95 MW to 270 MW. Estimates for Italy in 2008 range from 175 MW to 340 MW. Systèmes Solaires gives 200 MW added in Italy in 2008. Expert estimates put total grid-tied PV installations in 2008 at between 4.5 GW and 5.6 GW, with one estimate of off-grid PV at 0.3 GW. A small part of the disparities arise from tracking off-grid versus on-grid installations, as published global figures do not distinguish between these two, except for Systèmes Solaires for the EU. The disparity in estimates for total installed capacity also includes differences in how experts account for produced but uninstalled capacity, including project pipelines and excess inventory. In 2008 there was an estimated 1 GW or more of excess inventory that was not installed, as production far outstripped installation, and different methods of estimating this more precisely yield different totals. This is also the reason that estimates for 2008 may be revised in future years. Systèmes Solaires gives 5,350 MW cumulative for Germany and 3,400 MW cumulative for Spain in 2008, and EU cumulative of 9,500 MW. *Sources*: *PV News*/Prometheus Institute unpublished figures for 2008; European Photovoltaic Industries Association; Systèmes Solaires *Eur'Observer* 190, March 2009; news reports; expert estimates from report contributors.

Table R4. Renewable Electric Power Capacity, Existing as of 2008 (estimated)

Technology	World Total	Developing Countries	EU-27	China	United States	Germany	Spain	India	Japan
				Gigawatts					
Wind power	121	24	65	12.2	25.2	23.9	16.8	9.6	1.9
Small hydropower	85	65	12	60	3.0	1.7	1.8	2.0	3.5
Biomass power	52	25	15	3.6	8.0	3.0	0.4	1.5	>0.1
Solar photovoltaic-grid	13	>0.1	9.5	>0.1	0.7	5.4	3.3	~0	2.0
Geothermal power	10	4.8	0.8	~0	3.0	0	0	0	0.5
Solar thermal power–CSP	0.5	0	0.1	0	0.4	0	0.1	0	0
Ocean (tidal) power	0.3	0	0.3	0	0	0	0	0	0
Total renewable power capacity (excluding large hydro)	280	119	96	76	40	34	22	13	8
For comparison:									
Large hydropower	860								
Total electric power capacity	4,700								

Notes: Small amounts, on the order of a few megawatts, are designated by "~0." World total renewable power capacity rounded to nearest 5 GW. Figures should not be compared with prior versions of this table to obtain year-by-year increases, as some adjustments are due to improved data rather than changed capacities. *Sources*: Sources cited in Tables R2–R3; International Energy Agency (IEA) *Renewables Information 2008* (for OECD biomass power capacity); submissions from report contributors; historical databases going back to 2005 report edition (see Notes N3 through N7 of the *Renewables 2005 Global Status Report* and the notes associated with Table 4 in the 2006 Update and Endnote 11 in the *Renewables 2007 Global Status Report*).

Table R5. Solar Hot Water Installed Capacity, Top 10 Countries/EU and World Total, 2007

Country/EU	Additions 2007	Existing 2007
	gigawatts-thermal	
China	16	84
European Union	1.9	15.5
Turkey	0.7	7.1
Japan	0.1	4.9
Israel	0.05	3.5
Brazil	0.3	2.5
United States	0.1	1.7
India	0.2	1.5
Australia	0.1	1.2
Jordan	~0	0.6
(other countries)	< 0.5	< 3
World Total	**20**	**126**

Note: Figures do not include swimming pool heating (unglazed collectors). Existing figures include allowances for retirements. By accepted convention, 1 million square meters = 0.7 GWth. China added an estimated 14 GWth in 2008, which, along with extrapolating 2007 additions for other countries, yields a 2008 estimate of 145 GWth. *Source*: Werner Weiss and Irene Bergmann, and IEA Solar Heating and Cooling Programme, *Solar Heat Worldwide: Markets and Contributions to Energy Supply 2007*, edition 2009; also estimates by the China Renewable Energy Industries Association.

Table R6. Biofuels Production, Top 15 Countries plus EU, 2008

Country	Fuel ethanol	Biodiesel
	billion liters	
1. United States	34	2.0
2. Brazil	27	1.2
3. France	1.2	1.6
4. Germany	0.5	2.2
5. China	1.9	0.1
6. Argentina	—	1.2
7. Canada	0.9	0.1
8. Spain	0.40	0.3
9. Thailand	0.3	0.4
10. Colombia	0.3	0.2
11. Italy	0.13	0.3
12. India	0.3	0.02
13. Sweden	0.14	0.1
14. Poland	0.12	0.1
15. United Kingdom	—	0.2
EU Total	**2.8**	**8**
World Total	**67**	**12**

Note: Ethanol numbers are for fuel ethanol only. Table ranking by total biofuels. U.S. and Brazil ethanol figures rounded to nearest billion liters. *Sources*: F.O. Licht, *World Ethanol and Biofuels Report*; Argentina from Argentine Biofuels and Hydrogen Association; Brazil from Brazil Reference Center on Biomass (CENBIO).

Table R7 / Table R8 / Table R9

These tables have not been updated from the *Renewables 2007 Global Status Report*; see text in the policies section for added countries and updated targets, as well as forthcoming online tables at www.ren21.net.

Table R10. Cumulative Number of Countries/States/Provinces Enacting Feed-in Policies

Year	Cumulative Number	Countries/States/Provinces Added That Year
1978	1	United States
1990	2	Germany
1991	3	Switzerland
1992	4	Italy
1993	6	Denmark, India
1994	8	Spain, Greece
1997	9	Sri Lanka
1998	10	Sweden
1999	13	Portugal, Norway, Slovenia
2000	13	—
2001	15	France, Latvia
2002	21	Algeria, Austria, Brazil, Czech Republic, Indonesia, Lithuania
2003	28	Cyprus, Estonia, Hungary, South Korea, Slovak Republic, Maharashtra (India)
2004	33	Israel, Nicaragua, Prince Edward Island (Canada), Andhra Pradesh and Madhya Pradesh (India)
2005	40	Karnataka, Uttaranchal, and Uttar Pradesh (India); China, Turkey, Ecuador, Ireland
2006	43	Ontario (Canada), Argentina, Thailand
2007	49	South Australia (Australia), Albania, Bulgaria, Croatia, Macedonia, Uganda
2008	61	Queensland (Australia); California (USA); Gujarat, Haryana, Punjab, Rajasthan, Tamil Nadu, and West Bengal (India); Kenya, the Philippines, Poland, Ukraine
2009 (early)	63	Australian Capital Territory (Australia); South Africa

Note: Cumulative number refers to number of jurisdictions that had enacted feed-in policies as of the given year. A few feed-in policies shown have been discontinued. Many policies have been revised or reformulated in years subsequent to the initial year shown. India's national feed-in tariff from 1993 was substantially discontinued but new national feed-in tariffs were enacted in 2008. Three countries with feed-in tariffs are not shown because year of enactment is unknown: Costa Rica, Mauritius, and Pakistan. *Source*: All available policy references, including the IEA online Global Renewable Energy Policies and Measures database and submissions from report contributors. See also Endnote 35.

Table R11. Cumulative Number of Countries/States/Provinces Enacting RPS Policies

Year	Cumulative Number	Countries/States/Provinces Added That Year
1983	1	Iowa (USA)
1994	2	Minnesota (USA)
1996	3	Arizona (USA)
1997	6	Maine, Massachusetts, Nevada (USA)
1998	9	Connecticut, Pennsylvania, Wisconsin (USA)
1999	12	New Jersey, Texas (USA); Italy
2000	13	New Mexico (USA)
2001	15	Flanders (Belgium); Australia
2002	18	California (USA); Wallonia (Belgium); United Kingdom
2003	19	Japan; Sweden; Maharashtra (India)
2004	34	Colorado, Hawaii, Maryland, New York, Rhode Island (USA); Nova Scotia, Ontario, Prince Edward Island (Canada); Andhra Pradesh, Karnataka, Madhya Pradesh, Orissa (India); Poland
2005	38	District of Columbia, Delaware, Montana (USA); Gujarat (India)
2006	39	Washington State (USA)
2007	44	Illinois, New Hampshire, North Carolina, Oregon (USA); China
2008	49	Michigan, Missouri, Ohio (USA); Chile; India

Note: Cumulative number refers to number of jurisdictions that had enacted RPS policies as of the given year. Jurisdictions listed under year of first policy enactment; many policies are revised in subsequent years. *Source*: All available policy references, including the IEA online Global Renewable Energy Policies and Measures database, published sources as given in the endnotes and the 2007 report edition, and submissions from report contributors.

Table R12. Biofuels Blending Mandates

Country	Mandate
Australia	E2 in New South Wales, increasing to E10 by 2011; E5 in Queensland by 2010
Argentina	E5 and B5 by 2010
Bolivia	B2.5 by 2007 and B20 by 2015
Brazil	E22 to E25 existing (slight variation over time); B3 by 2008 and B5 by 2013
Canada	E5 by 2010 and B2 by 2012; E7.5 in Saskatchewan and Manitoba; E5 by 2007 in Ontario
Chile	E5 and B5 by 2008 (voluntary)
China	E10 in 9 provinces
Colombia	E10 and B10 existing
Dominican Republic	E15 and B2 by 2015
Germany	E5.25 and B5.25 in 2009; E6.25 and B6.25 from 2010 through 2014
India	E5 by 2008 and E20 by 2018; E10 in 13 states/territories
Italy	E1 and B1
Jamaica	E10 by 2009
Korea	B3 by 2012
Malaysia	B5 by 2008
Paraguay	B1 by 2007, B3 by 2008, and B5 by 2009; E18 (or higher) existing
Peru	B2 in 2009; B5 by 2011; E7.8 by 2010
Philippines	B1 and E5 by 2008; B2 and E10 by 2011
South Africa	E8–E10 and B2–B5 (proposed)
Thailand	E10 by 2007 and B10 by 2012; 3 percent biodiesel share by 2011
United Kingdom	E2.5/B2.5 by 2008; E5/B5 by 2010
United States	Nationally, 130 billion liters/year by 2022 (36 billion gallons); E10 in Iowa, Hawaii, Missouri, and Montana; E20 in Minnesota; B5 in New Mexico; E2 and B2 in Louisiana and Washington State; Pennsylvania 3.4 billion liters/year biofuels by 2017 (0.9 billion gallons)
Uruguay	E5 by 2014; B2 from 2008–11 and B5 by 2012

Note: Table shows binding obligations on fuel suppliers; there are other countries with future indicative targets that are not shown here; see the Biofuels Policies section. Some mandates shown may be delayed by market issues. Mandates in some U.S. states only take effect in future years or under certain future conditions, or apply only to portions of gasoline sold. *Source*: All available policy references, including the IEA online Global Renewable Energy Policies and Measures database and submissions from report contributors.

FURTHER INFORMATION AND SOURCES OF DATA

This 2009 report edition follows previous editions in 2005, 2006, and 2007 (*Renewables 2005 Global Status Report, Renewables Global Status Report 2006 Update,* and *Renewables 2007 Global Status Report*). To save space, these notes highlight some of the most important considerations and details and refer the reader to these previous editions for further information and sources, including the endnotes to the 2006 and 2007 editions, the lists of references for the 2006 and 2007 editions, and Notes N1 through N44 of the 2005 edition, which are contained in the separate 80-page *Renewables 2005 Global Status Report–Notes and References Companion Document*. All of these documents can be found on the REN21 Web site, at www.ren21.net. Thus, *this 2009* Update edition is not intended as a stand-alone document, but includes by reference all the material from these previous editions, and particularly from the full 2007 edition, including the comprehensive notes and explanations of methodologies, caveats, and sources.

Most figures of global capacity, growth, and investment portrayed in this report are not exact but are approximate to two significant digits. Where necessary, triangulation of conflicting, partial, or older information is made using assumptions and growth trends. The original 2005 report drew from more than 250 published references, plus a variety of electronic newsletters, numerous unpublished submissions from contributors, personal communications, and Web sites. Subsequent editions have added many more sources. There has generally been no single source of information for any fact globally, as most existing sources report only on developed (OECD) countries or on regional or national levels, such as Europe or the United States, although global sources have emerged in recent years for wind power, solar PV, solar hot water, and ethanol. Some global aggregates must be built from the bottom up, adding or aggregating individual country information. Very little material exists that covers developing countries as a group. Data for developing countries is often some years older than data for developed countries, and thus extrapolations to the present must be made from older data, based on assumed and historical growth rates. This is one of the reasons that capacity data (kilowatts) instead of energy data (kilowatt-hours) are reported, as capacity expansion is easier to extrapolate than energy production and is less prone to seasonal and annual variations that are common to many forms of renewables. (Other reasons are that capacity data better mimic investment trends over time, as capacity is usually directly proportion to investment, while energy production is not; and capacity data are generally more available for developing countries than energy production.) Exact annual increments to capacity are generally available only for wind, solar PV, and solar hot water.

ENDNOTES

1 The primary yearbooks for wind power are: Global Wind Energy Council (GWEC), *Global Wind Report 2008* (Brussels: 2009) and World Wind Energy Association (WWEA), *Wind Energy International 2007/2008* and *World Wind Energy Report 2008* (Bonn: 2009). Offshore wind capacity from European Wind Energy Association (EWEA), "Offshore Statistics January 2009" and "Wind Now Leads EU Power Sector," press releases (Brussels: 2 February 2009).

2 Statistics on hydropower, either large or small, are not readily available from published sources on a global total basis. The REN 21 *Renewables 2007 Global Status Report* estimated 770 GW of large hydro and 73 GW of small hydro for 2006, for a total of 843 GW of hydro in 2006. The small hydro figures are based on a database by Eric Martinot first created from the World Energy Council's *Survey of Energy Resources* in 1999 and subsequently updated with actual data from developing countries as collected from report country correspondents and individual country research. For further discussion on hydro statistics, see Note N5 of the *Renewables 2005 Global Status Report* and Endnote 1 of the *Renewables Global Status Report 2006 Update*. The International Hydropower Association (IHA) estimates a total of 39 GW of hydro (both large and small) added in 2008, and a global total of 950 GW in 2008. Given an estimated 5–8 GW of small hydro added annually in recent years, mostly in China, and an estimated 7.5 GW of large hydro in China in 2007 (and 12–14 GW globally for 2007), the 39 GW number for 2008 seems high but is nevertheless used as the basis for the figures cited in the text. The 950 GW global total from IHA implies that the prior estimate of 770 GW of large hydro for 2006 was about 40 GW too low. The justification for continuing to attempt to report small and large hydro separately is multifold: many countries (for example China) continue to report these statistics separately; many country policy targets or programs only include small hydro as qualifying for the targets or programs (for example Brazil), and thus small hydro needs to be tracked separately for comparison and scale purposes; and the 280 GW of "new renewables" as reported in Table R4, including only small hydropower, is an accepted and sought-after metric in the literature that reflects the growth of those renewables most influenced by the types of polices discussed in this report. (The IHA global total of 950 GW is for all scales of hydro excluding pumped storage and also excludes plants under construction, shutdown/on standby, deactivated/mothballed, retired, deferred without construction start, and delayed after construction start.)

3 Statistics on biomass power generation from a database by Martinot with country-by-country numbers collected since 2004 from submissions by report contributors and individual country research, along with OECD biomass power generation statistics (excluding capacity from municipal waste) provided in International Energy Agency (IEA), *Renewables Information 2008* (Paris: 2008). In general, progress with biomass power is very difficult to track globally. There was also a substantial amount of biomass co-fired with coal, for example in the United Kingdom, but updated data were not available.

4 Estimates for solar PV vary significantly by source, which is why Italy and South Korea are expressed as ranges; see notes associated with Table R3 for further details and sources of information. China's new market is based on a newly adopted subsidy policy discussed in Section 4. The Spanish solar PV market in 2009 was not expected to repeat the 2008 performance, as the solar PV target was achieved and policy support was being scaled back; see discussion in Section 4. There are very few estimates available of total cumulative installed solar PV worldwide; one is from Photon Consulting, which gave 16.4 GW in 2008 for on-grid and off-grid combined. This is consistent with the 17 GW cited here, which comes from Table R3 and an historical build-up of cumulative installations in all markets by Martinot dating back to the 1990s.

5 More than 1.5 GW of utility-scale plants are under contract in the United States, according to the Solar Electric Power Association (SEPA). Global statistics on utility-scale plants from Denis Lenardic, pvresources.com, in particular "PVResources Annual Report 2008: Large Commercial Photovoltaic Power Plants with more than 3200 MW at the Network."

6 U.S. Geothermal Energy Association (GEA), "U.S. Geothermal Power Production and Development Update, March 2009," cited in "Geothermal Power Continues Strong Growth, New Industry Report Shows," RenewableEnergyWorld.com, 4 March 2009; Karl Gawell and Griffin Greenberg, *2007 Interim Report: Update on World Geothermal Development* (Washington, DC: GEA, 1 May 2007); Ruggero Bertani, "World Geothermal Generation in 2007," in *Proceedings, European Geothermal Congress 2007, Unterhaching, Germany, 30 May–1 June 2007*. Bertani listed top countries for geothermal power as of 2007: United States (2.69 GW), Philippines (1.97 GW), Indonesia (992 MW), Mexico (952 MW), Italy (810 MW), Japan (535 MW), New Zealand (471 MW), and Iceland (421 MW). According to Gawell and Greenberg, potential new countries with geothermal power are Armenia, Canada, Chile, Djibouti, Dominica, Greece, Honduras, Hungary, India, Iran, Korea, Nevis, Rwanda, Slovakia, Solomon Islands, St. Lucia, Switzerland, Taiwan, Tanzania, Uganda, Vietnam, and Yemen.

7 The Liddell power plant in New South Wales, Australia, also had a small solar thermal array installed in 2008, with larger-scale upgrades planned for the future. For further details of the CSP plants completed in 2006–07 and those under development, including two other World Bank/Global Environment Facility projects for integrated CSP with natural gas combined-cycle plants, see *Renewables 2007 Global Status Report*, p. 12. CSP information from a variety of news sources, unpublished information from report contributors, and U.S. Solar Energy Industries Association (SEIA), *US Solar Industry Year in Review 2008* (Washington, DC: 2009), pp. 6–7.

8 U.S. power capacity shares from Prometheus Institute, "New Electric Capacity in US Shifts to Renewables," *Renewable Energy Industry Note* (Chicago: 25 March 2009); EU power capacity shares from EWEA, op. cit. note 1. Data for EU in 2008 were 23.8 GW total, of which wind was 8.5 GW, gas 6.9 GW, solar PV 4.2 GW, oil 2.5 GW, coal 0.8 GW, hydro 0.5 GW, and nuclear 0.06 GW.

9 Solar hot water data from the following sources: individual country submissions by report contributors; European Solar Thermal Industries Association; and Werner Weiss, Irene Bergman, and Roman Stelzer, *Solar Heat Worldwide: Markets and Contribution to the Energy Supply 2007* (Paris: IEA Solar Heating and Cooling Programme, April 2009). Many developing country markets are being assisted by specific programs; for example, Tunisia's PROSOL program to promote solar hot water had resulted in over 150 MWth of new capacity by 2008.

10 There are no annual published sources giving total geothermal capacity worldwide; see the *Renewables 2007 Global Status Report* for previous geothermal sources, supplemented for 2008 with unpublished submissions from report contributors.

11 See sources for Table R6. Brazil transportation fuel share from Clean Edge, *Clean Energy Trends 2009* (San Francisco: March 2009).

12 See sources for Table R6. Europe biodiesel production capacity from European Biodiesel Board. Biodiesel production actually declined in Germany in 2008, according to some reports, given reduced policy incentives.

13 Investment numbers in this *2009 Update* edition are based on a different methodology from prior editions, one of which uses statistics from New Energy Finance (NEF). Estimate of $120 billion is based on NEF categories for asset finance and small projects combined, only for renewables, and excludes the other finance categories reported elsewhere by NEF (private equity/venture capital, public markets, and mergers/acquisitions). The NEF numbers used in Figure 8 for years prior to 2007 are higher than numbers given in prior editions of the *Renewables Global Status Report* for several reasons. First, NEF "asset financing" numbers represent investment raised in each year—i.e., equity that is committed, or debt that is provided (sometimes in tranches). The plant or project being financed may not be commissioned in the same year (given the lead/construction times in each sector—up to 18 months in biofuels). Some investment in each year will translate into new capacity in the following year. Hence, the capacity commissioned times the average capex per unit (MW/mLpa etc) in each year will not exactly match the financing we have recorded (especially for biofuels). Second, past editions of the *Renewables Global Status Report* have defined "investment in new renewable energy capacity" to exclude investment in biofuels refineries; however, biofuels refineries are certainly a legitimate form of "capacity" and thus should be included in the totals. (Previous editions report biofuels refineries separately, but probably also underestimated the absolute numbers.). Also, note that other published NEF figures report on "clean energy," while the figures used here are only for renewables (although the differences are not that significant, as the vast majority of NEF statistics cover renewables). The figures used here for wind and solar PV closely correspond with investment figures published by other organizations. GWEC and WWEA estimate $48–52 billion in new wind power capacity investment in 2008; the NEF number is $49 billion. Clean Edge estimates solar PV (including modules, system components and installation) at $29.6 billion in 2008, per "Another Year of Banner Growth in 2008, But Clean-Energy Sector Looks to Stimulus for Help in 2009," CleanEdge.com, 11 March 2009. This corresponds with an NEF figure of $39 billion and a figure of $37 billion based on $7/watt cost (5.4 GW times $7/watt); it is likely that Clean Edge used a lower total than 5.3 GW, as numbers were in flux.

14 KfW's "Special Facility for Renewable Energies and Energy Efficiency" was established in 2005 to provide concessional loans as part of Germany's international development cooperation; it was to provide a total of €1.3 billion for the period 2005–11.

15 Many of the provisions of fiscal stimulus announcements in late 2008/early 2009 were later changed when legislation was finally enacted. Many final stimulus amounts contained only small shares specifically for renewable energy. The China announcement is cited in Louis Schwartz, "China's New Generation: Driving Domestic Development," *Renewable Energy World*, January 2009. Germany announced a total of €80 billion over two years, but only part of this was for renewables.

16 Market capitalization statistics and analysis courtesy of New Energy Finance and Chris Greenwood.

17 *PV News*, April 2009; Travis Bradford, Prometheus Institute, e-mail to Janet Sawin, Worldwatch Institute, 11 March 2009.

18 *PV News*, April 2009.

19 Solar PV industry reports come from a large number of press reports and publications, such as *PV News* and *SolarBuzz*.

20 Jaideep Malaviya, "On a Solar Mission: How India Is Becoming a Centre of PV Manufacturing," *Renewable Energy World,* September/October 2008.

21 China wind industry estimates from China Wind Energy Association, China Renewable Energy Industries Association (CREIA), and submissions from report contributors.

22 Manufacturer rankings from BTM Consult ApS, *BTM Wind Market Report 2008* (Ringkøbing, Denmark: 2009). U.S. manufacturing facilities from American Wind Energy Association, "WEA Annual Wind Energy Industry Report Reflects Strong Growth in 2008, Dramatic Increase in Manufacturing," press release (Washington, DC: 13 April 2009); see also Elisa Wood, "High Winds for Texas: Lone Star State is Stepping Up," *Renewable Energy World*, September/October 2008.

23 Recent information on CSP developments from news reports and submissions from report contributors.

24 Industry information based primarily on country submissions from report contributors. Argentina data from Biofuels and Hydrogen Argentine Association (La Gaceta, S. M. de Tucumán: 9 January 2009) and from Camara Argentina de Energias Renovables (Argentine Renewable Energies Chamber), "Outlook for the Argentine Biodiesel Industry" (Buenos Aires: 2008), p. 3. U.S. ethanol data partly from Renewable Fuels Association, "Growing Innovation: America's Energy Future Starts at Home," in *2009 Ethanol Industry Outlook* (Washington, DC: February 2009). The economic downturn of 2008 and reduced oil prices have had a severe impact on U.S. ethanol production: experts estimated idling of more than 20 percent of production as of March 2009 and as much as 15 percent of production capacity during the 2009/2010 marketing year, per Timothy Garner, "Pacific Ethanol Suspends Plants in Idaho, California," *Reuters*, 2 March 2009. In Europe, due to changes in governmental support schemes and concerns about overall sustainability, biodiesel production is facing severe economic challenges, with several plants being shut down, for example in Germany. Furthermore, global trade in biodiesel (especially exports to the EU from the United States) increased and raised questions about subsidies.

25 Second-generation ethanol is covered extensively in Ralph Sims et al., From *1st- to 2nd-Generation Biofuel Technologies: An Overview of Current Industry and RD&D Activities* (Paris: IEA/OECD, 2008). Current plants under construction and planned from F.O. Licht, *World Biofuels Report*, 13 March 2009.

26 Solar PV and wind power provided more than 600,000 direct and indirect jobs globally in 2008 and are expected to generate 2.7 million jobs by 2018, per Clean Edge, op. cit. note 11.

27 The term "target" is used rather loosely in this section and encompasses many different types of policy processes, such as legislative mandates, executive or ministerial statements and programs, other types of announced goals and plans, and pledges made as part of international action programs (from Bonn Renewables 2004, Beijing International Renewable Energy Conference 2005, and Washington International Renewable Energy Conference 2008 (WIREC)). It is very difficult to conclusively separate and categorize targets by type across all countries.

28 The original 10 percent target was envisioned to be met entirely with biofuels, but the final 10 percent target is for renewable transport including electric vehicles. From 2017 onward, the greenhouse gas emission savings of biofuels produced in existing production plants must be at least 50 percent compared to fossil fuels. The greenhouse gas emissions of biofuels produced in new installations will have to be at least 60 percent lower than those from fossil fuels. It was also proposed, but not adopted, that at least 40 percent of the 10 percent transport renewable energy must come from second-generation biofuels, electricity, and/or hydrogen. Latvia's target changed from 42 percent to 40 percent.

29 There are additional targets beyond those in Tables R7–R9 of the *Renewables 2007 Global Status Report* that were established previously to 2008 that were unintentionally omitted, including Denmark (20 percent gross energy consumption by 2011); Norway (political goal of 30 TWh renewable thermal and electric energy and energy savings in 2016 compared to 2001 levels); Albania (target updated in 2007: non-hydro renewable energy to 18 percent of primary energy supply by 2020; all renewable energy to 40 percent); and Sweden (target set in 2007: 10 TWh wind production by 2015). India set a target of 50 MW of solar power generation during the 11th plan. Israel has stated that by 2020, 10–20 percent of the country's energy production will be solar. Some of the targets mentioned for 2008 may have been enacted in a prior year but were not included in the 2007 report edition and were newly identified in 2008. Targets noted for Brazil, Cape Verde, Jamaica, Kenya, Madagascar, Nicaragua, Rwanda, and Tunisia are pledges made publicly at WIREC in March 2008, or afterward, but not necessarily backed by specific legislation. In early 2009, Morocco changed the targets mentioned in Tables R7 and R8 in the 2007 report, to 8 percent of primary energy and 18 percent of electricity by 2012. Also noteworthy was President Barack Obama's proposed plan for a national U.S. goal of 10 percent of electricity from renewables by 2012 and 25 percent by 2025, although it was not yet backed by legislation. Tunisia's target appears to be 180 MW of wind by 2012, not the 300 MW cited in Table R9 of the 2007 report edition. Croatia's target of 400 MW by 2010 from Table R9 appears to have changed to 400 MW of wind power by 2030.

30 The 33 states/provinces with RPS standards also includes the District of Columbia. U.S. state policies from North Carolina Solar Center, Database of State Incentives for Renewables and Efficiency (DSIRE), electronic database, available at www.dsireusa.org. The *Renewables 2007 Global Status Report* listed 4 U.S. states with non-RPS targets and 6 Canadian provinces with non-RPS targets (see Endnote 53 of the 2007 report). There are now at least 7 U.S. states/territories and 6 Canadian provinces with non-RPS targets. Nova Scotia, in addition to its RPS, also enacted in early 2009 a new non-RPS target of 25 percent share of energy by 2020. The previous target reported for Newfoundland/Labrador does not actually exist.

31 A complete table of existing targets for sub-national jurisdictions is forthcoming on the Web site www.ren21.net. Many existing sub-national targets were catalogued in the text of previous editions of the *Renewables Global Status Report* but no comprehensive table yet exists.

32 Provinces with wind power bases are Gansu, Hami, Xinjiang, Eastern and Western Inner Mongolia, and Jiangsu; see Schwartz, op. cit. note 15. There were also provincial targets in China emerging, for example a 2007 target in Hainan Province for 400 MW of wind capacity by 2015 and 600 MW by 2020. The 100 GW by 2020 implied by RPS policy was calculated by Steve Sawyer of the GWEC and Li Junfeng of the CREIA.

33 Information on policies comes from a wide variety of sources, including the IEA Renewable Energy Policies and Measures Database, the U.S. DSIRE database, RenewableEnergyWorld.com, press reports, submissions from report contributors, and a wide range of unpublished data. Some policies may not be included in the text due to errors of omission and the difficulties of capturing all information. Table 2 is updated every second year with full versions of this report; this update version attempts to mention in the text and endnotes most of the changes since 2007. Bulgaria, Macedonia, Mauritius, and Pakistan were unintentionally omitted from Table 2 in 2007 but apparently have feed-in tariffs from some previous year. These countries are not included in Table R10 because the year of enactment is unknown. Countries adopting new promotion policies for the first time in 2008 and early 2009 (as additions to Table 2) include Kenya, Syria, and Ukraine. Egypt was in the process of enacting a new policy to support renewables. Additional policies for Chile exist beyond those shown in Table 2, including tax credits and public investment.

34 There is now a large literature on feed-in tariffs with many sources of information; see, for example, Miguel Mendonca, *Feed-In Tariffs:*

Accelerating the Deployment of Renewable Energy (London: Earthscan, 2007) and Paul Gipe's extensive data at www.wind-works.org, plus other references listed in the Renewables 2007 Global Status Report. The current report takes a broad definition of feed-in tariff but also excludes some policies that are considered minor or capped at very low levels of capacity (such as enabling just a few hundred small generators, as was the case for the 2008 feed-in tariff for solar PV in Wisconsin in the United States), as one of the defining characteristics of a feed-in tariff is guaranteed purchasing of power from all renewable generators. India's new feed-in tariff was capped at 50 MW through 2009, although a second policy phase may increase the program cap to 1,000 MW. The tariff provides up to 12 Rupees per kWh for Solar PV projects promising a 10-year commitment with a cap of 50 MW. There were also additional measures that went along with the feed-in tariff, per Indian Ministry of New and Renewable Energy, "Guidelines for Generation Based Incentive Grid Interactive Solar PV Power Generation Projects" (New Delhi: January 2008). The Poland feed-in tariff is apparently based on prior-year market prices, rather than special renewable-specific prices, so might be characterized more as a purchase obligation on utilities, and also includes green certification and verification provisions.

35 Ontario had a prior, more limited feed-in tariff. The U.S. states of Washington, Wisconsin, and Michigan have enacted limited feed-in tariffs for solar PV but restrict the amount of capacity that can be installed. The Australian Northern Territory also had a limited feed-in tariff for a small number of systems in Alice Springs. Feed-in tariffs were expected during 2009 in Tasmania, Victoria, and New South Wales. In India, several state governments followed the national feed-in tariff by announcing feed-in tariff incentives with caps ranging from 50 MW to 500 MW, the most prominent among them being West Bengal, Gujarat, Haryana, Rajasthan, Punjab, and Tamil Nadu. Gujarat recently announced a policy to target 500 MW in the state. The feed-in tariff will be $0.27/kWh for a period of 12 years. The maximum size per project is 5 MW to enable more customers. Developers will also have access to an 80 percent accelerated depreciation benefit under the Income Tax Act.

36 It should be noted that some of these policy changes were expected to have large impacts on markets in 2009; for example, Spain's revised tariffs were expected to seriously affect global PV demand, given Spain's 2008 market leadership. Switzerland's new regime provides relatively high payments (compared to other European countries) for 20–25 years for most technologies including small wind generators under 10 kW. The Swiss program has annual capacity caps, however, and by February 2009 the annual cap for solar PV was already reached.

37 Missouri had a voluntary goal that was converted to mandatory via a ballot initiative in November 2008; the RPS includes a solar carve-out. For the Ohio RPS, alternative energy must account for at least 25 percent of electricity by 2025, and renewable energy must represent at least half of that amount; the RPS also includes a solar carve-out. Maryland from SEIA, op. cit. note 7, p. 4.

38 In Berkeley, a pilot $1.5 million program started in 2008, following which the city plans to issue $80 million in bonds to provide 20-year loans to homeowners with repayment added to property taxes.

39 The U.S. PTC was extended in late 2008 for wind power through 2009 and for geothermal through 2010, but these extensions were subsequently superseded by further extensions enacted in early 2009. Additional provisions allow project developers who qualify for the PTC have the option to use the 30 percent investment tax credit (ITC) instead, or can apply for a grant in lieu of the ITC.

40 The final capacity amounts under Brazil's PROINFA program were 1,191 MW of small hydro, 1,423 MW of wind power, and 685 MW of biomass, totaling 3,300 MW. China repealed two VAT refund allowances that applied to imported capital goods and to purchases of domestic equipment by private foreign firms, and replaced them with a full "refund" of VAT and import duties on imported wind turbine components for use in turbines of 1.2 MW and larger. But one analyst said the new refund provision really only applied to domestic state-owned enterprises, as private foreign firms could not take equal advantage of the refund mechanism used. This is a complicated issue.

41 Baden-Württemberg from "First Heating Law for Renewable Energy in Germany," *Energy-Server* (REECO GmbH), 2 August 2008. For more on the German Renewable Energies Heat Act, see Federal Ministry for the Environment, Nature Conservation and Nuclear Safety, "Heat from Renewable Energies: What Will the New Heat Act Achieve?" (Berlin: July 2008).

42 A law in Brazil requires energy utilities to invest 0.5 percent of revenue in energy efficiency projects, and some utilities are using these funds to finance solar hot water in homes and public buildings.

43 New Zealand formerly had blending mandates but these were repealed. Brazil changed its biodiesel mandate from B2 to B3 in 2008.

44 There are no published sources that report comprehensively on green power globally, so all information must be compiled country-by-country based on submissions from report contributors.

45 Los Angeles target from Elaine Rundle, "Solar LA Green Initiative Is Most Ambitious Citywide Renewable Energy Plan," *Emergency Management News*, 25 November 2008, at www.govtech.com/em/articles/565314.

46 Covenant of Mayors network as of April 2009, from www.eumayors.eu.

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REN21 Renewable Energy Policy Network for the 21st Century