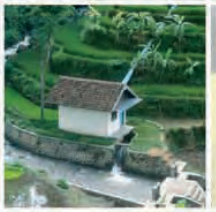
RENEWABLES 2010
GLOBAL STATUS REPORT












REN21 Renewable Energy Policy Network for the 21st Century

EXECUTIVE SUMMARY

Changes in renewable energy markets, investments, industries, and policies have been so rapid in recent years that perceptions of the status of renewable energy can lag years behind the reality. This report captures that reality and provides a unique overview of renewable energy worldwide as of early 2010. The report covers both current status and key trends. By design, the report does not provide analysis, discuss current issues, or forecast the future.

Many of the trends reflect the increasing significance of renewable energy relative to conventional energy sources (including coal, gas, oil, and nuclear). By 2010, renewable energy had reached a clear tipping point in the context of global energy supply. Renewables comprised fully one-quarter of global power capacity from all sources and delivered 18 percent of global electricity supply in 2009. In a number of countries, renewables represent a rapidly growing share of total energy supply—including heat and transport. The share of households worldwide employing solar hot water heating continues to increase and is now estimated at 70 million households. And investment in new renewable power capacity in both 2008 and 2009 represented over half of total global investment in new power generation.

Trends reflect strong growth and investment across all market sectors—power generation, heating and cooling, and transport fuels. Grid-connected solar PV has grown by an average of 60 percent *every year* for the past *decade*, increasing 100-fold since 2000. During the past five years from 2005 to 2009, consistent high growth year-after-year marked virtually every other renewable technology. During those five years, wind power capacity grew an average of 27 percent annually, solar hot water by 19 percent annually, and ethanol production by 20 percent annually. Biomass and geothermal for power and heat also grew strongly.

Much more active policy development during the past several years culminated in a significant policy milestone in early 2010—more than 100 countries had enacted some type of policy target and/or promotion policy related to renewable energy, up from 55 countries in early 2005. Many new targets enacted in the past three years call for shares of energy or electricity from renewables in the 15–25 percent range by 2020. Most countries have adopted more than one promotion policy, and there is a huge diversity of policies in place at national, state/provincial, and local levels.

Many recent trends also reflect the increasing significance of developing countries in advancing renewable energy. Collectively, developing countries have more than half of global renewable power capacity. China now leads in several indicators of market growth. India is fifth worldwide in total existing wind power capacity and is rapidly expanding many forms of rural renewables such as biogas and solar PV. Brazil produces virtually all of the world's sugar-derived ethanol and has been adding new biomass and wind power plants. Many renewables markets are growing at rapid rates in countries such as Argentina, Costa Rica, Egypt, Indonesia, Kenya, Tanzania, Thailand, Tunisia, and Uruguay, to name a few. Developing countries now make up over half of all countries with policy targets (45 out of 85 countries) and also make up half of all countries with some type of renewable energy promotion policy (42 out of 83 countries).

The geography of renewable energy is changing in ways that suggest a new era of geographic diversity. For example, wind power existed in just a handful of countries in the 1990s but now exists in over 82 countries. Manufacturing leadership is shifting from Europe to Asia as countries like China, India, and South Korea continue to increase their commitments to renewable energy. In 2009, China produced 40 percent of the world's solar PV supply, 30 percent of the world's wind turbines (up from 10 percent in 2007), and 77 percent of the world's solar hot water collectors. Latin America is seeing many new biofuels producers in countries like Argentina, Brazil, Colombia, Ecuador, and Peru, as well as expansion in many other renewable technologies. At least 20 countries in the Middle East, North Africa, and sub-Saharan Africa have active renewable energy markets. Outside of Europe and the United States, other developed countries like Australia, Canada, and Japan are seeing recent gains and broader technology diversification. The increasing geographic diversity is boosting confidence that renewables are less vulnerable to policy or market dislocations in any specific country.

One of the forces propelling renewable energy development is the potential to create new industries and generate millions of new jobs. Jobs from renewables now number in the hundreds of thousands in several countries. Globally, there are an estimated 3 million direct jobs in renewable energy industries, about half of them in the biofuels industry, with additional indirect jobs well beyond this figure.

Greatly increased investment from both public-sector and development banks is also driving renewables development, particularly from banks based in Europe, Asia, and South America. The European Investment Bank and the Brazilian Development Bank (BNDES) are notable cases. A number of development banks have increased development assistance flows. Such flows jumped to over $5 billion in 2009, compared with some $2 billion in 2008. The largest providers are the World Bank Group, Germany's KfW, the Inter-American Development Bank, and the Asian Development Bank. Dozens of other development agencies provide growing amounts of loans, grants, and technical assistance for renewables.

Other ongoing market and industry trends include:

Wind power. Trends include new growth in off shore development, the growing popularity of distributed, small-scale grid-connected turbines, and new wind projects in a much wider variety of geographical locations around the world and within countries. Firms continue to increase average turbine sizes and improve technologies, such as with gearless designs.

Biomass power. Biomass power plants exist in over 50 countries around the world and supply a growing share of electricity. Several European countries are expanding their total share of power from biomass, including Austria (7 percent), Finland (20 percent), and Germany (5 percent). Biogas for power generation is also a growing trend in several countries.

Grid-connected solar PV. The industry has been responding to price declines and rapidly changing market conditions by consolidating, scaling up, and moving into project development. Thin-film PV has experienced a rapidly growing market share in recent years, reaching 25 percent. A growing of number of solar PV plants are so-called "utility-scale" plants 200-kW and larger, which now account for one-quarter of total grid-connected solar PV capacity.

Geothermal power. Geothermal power plants now exist in 19 countries, and new plants continue to be commissioned annually—for example in Indonesia, Italy, Turkey, and the United States in 2009.

Concentrating solar thermal power (CSP). CSP emerged as a significant new power source during 2006–2010, after initial stalled development some two decades earlier. By early 2010, 0.7 GW of CSP was in operation, all in the U.S. Southwest and Spain, with construction or planning under way for much more capacity in many more countries.

Solar hot water/heating. China continues to dominate the world market for solar hot water collectors, with some 70 percent of the existing global capacity. Europe is a distant second with 12 percent. Virtually all installations in China are for hot water only. But there is a trend in Europe toward larger 'combi' systems that provide both water and space heating; such systems now account for half of the annual market.

Biomass and geothermal heating. Biomass heating markets are expanding steadily, particularly in Europe. Trends include growing use of solid biomass pellets, use of biomass in building-scale or community-scale combined-heat-and-power plants (CHP), and use of biomass for centralized district heating systems. Use of geothermal direct-use heat plants and ground-source heat pumps is also growing.

Globally, there exists some 500 gigawatts-thermal (GWth) of heating capacity from biomass (270 GWth), solar (170 GWth), and geothermal (60 GWth).

Biofuels. Corn ethanol, sugar ethanol, and biodiesel are the primary biofuels markets, although others like biogas for transport and other forms of ethanol are also significant. Corn accounts for more than half of global ethanol production, and sugar cane for more than one-third. The United States and Brazil accounted for almost 90 percent of global ethanol production. The second-generation biofuels industry has seen many research and pilot-production plants commissioned, most with some form of partial public funding.

Highlights of 2009

The year 2009 was unprecedented in the history of renewable energy, despite the headwinds posed by the global financial crisis, lower oil prices, and slow progress with climate policy. Indeed, as other economic sectors declined around the world, existing renewable capacity continued to grow at rates close to those in previous years, including grid-connected solar PV (53 percent), wind power (32 percent), solar hot water/heating (21 percent), geothermal power (4 percent), and hydropower (3 percent). Annual production of ethanol and biodiesel increased 10 percent and 9 percent, respectively, despite layoffs and ethanol plant closures in the United States and Brazil.

Highlights of 2009 include:

- For the second year in a row, in both the United States and Europe, more renewable power capacity was added than conventional power capacity (coal, gas, nuclear). Renewables accounted for 60 percent of newly installed power capacity in Europe in 2009, and nearly 20 percent of annual power production.
- China added 37 GW of renewable power capacity, more than any other country in the world, to reach 226 GW of total renewables capacity. Globally, nearly 80 GW of renewable capacity was added, including 31 GW of hydro and 48 GW of non-hydro capacity.
- Wind power additions reached a record high of 38 GW. China was the top market, with 13.8 GW added, representing more than one-third of the world market—up from just a 2 percent market share in 2004. The United States was second, with 10 GW added. The share of wind power generation in several countries reached record highs, including 6.5 percent in Germany and 14 percent in Spain.
- Solar PV additions reached a record high of 7 GW. Germany was the top market, with 3.8 GW added, or

more than half the global market. Other large markets were Italy, Japan, the United States, Czech Republic, and Belgium. Spain, the world leader in 2008, saw installations plunge to a low level in 2009 after a policy cap was exceeded.

- Many countries saw record biomass use. Notable was Sweden, where biomass accounted for a larger share of energy supply than oil for the first time.
- Biofuels production contributed the energy equivalent of 5 percent of world gasoline output.
- Almost all renewable energy industries experienced manufacturing growth in 2009, despite the continuing global economic crisis, although many capital expansion plans were scaled back or postponed. Impaired access to equity markets, difficulty in obtaining finance, and industry consolidations negatively affected almost all companies.
- Nearly 11 GW of solar PV was produced, a 50-percent increase over 2008. First Solar (USA) became the first firm ever to produce over 1 GW in a single year. Major crystalline module price declines took place, by 50–60 percent by some estimates, from highs of $3.50 per watt in 2008 to lows approaching $2 per watt.
- Wind power received more than 60 percent of utility-scale renewables investment in 2009 (excluding small projects), due mostly to rapid expansion in China.
- Investment totals in utility-scale solar PV declined relative to 2008, partly an artifact of large drops in the costs of solar PV. However, this decline was offset by record investment in small-scale (rooftop) solar PV projects.
- Investment in new biofuels plants declined from 2008 rates, as corn ethanol production capacity was not fully utilized in the United States and several firms went bankrupt. The Brazilian sugar ethanol industry likewise faced economic troubles, with no growth despite ongoing expansion plans. Europe faced similar softening in biodiesel, with low production capacity utilization.
- "Green stimulus" efforts since late-2008 by many of the world's major economies totaled close to $200 billion, although most stimulus was slow to start and less than 10 percent of green stimulus funds was spent during 2009.

For more 2009 data and country rankings, see the Selected Indicators and Top Five Countries tables on page 13.

A Dynamic Policy Landscape

Policies to promote renewable energy existed in a few countries in the 1980s and early 1990s, but policies emerged in many more countries, states, provinces, and cities during the past 15 years and especially during the period 2005–2010.

By 2009, over 85 countries had some type of policy target, up from 45 countries in 2005. Many national targets are for shares of electricity production, typically 5–30 percent, but range as high as 90 percent. Other targets are for shares of total primary or final energy supply (typically 10–20 percent), specific installed capacities of various technologies, or total amounts of energy production from renewables. Most recent targets aim for 2020 and beyond. Europe's target (20 percent of final energy by 2020) is prominent among OECD countries. Among developing countries, examples include Brazil (75 percent of electricity by 2030), China (15 percent of final energy by 2020), India (20 GW solar by 2022), and Kenya (4 GW of geothermal by 2030). Many targets also exist at the state, provincial, and local levels.

At least 83 countries have some type of policy to promote renewable power generation. The most common policy is the feed-in tariff, which has been enacted in many new countries and regions in recent years. By early 2010, at least 50 countries and 25 states/provinces had feed-in tariffs, more than half of these adopted only since 2005. Strong momentum for feed-in tariffs continues around the world as countries continue to establish or revise policies. States and provinces have been adopting feed-in tariffs in increasing numbers as well.

Renewable portfolio standard (RPS) policies, also called renewable obligations or quotas, have been enacted by 10 national governments and 46 state/provincial governments around the world. Most RPS policies require renewable power shares in the range of 5–20 percent, with many targets extending to 2020 and beyond.

Many other types of policies have been adopted, most often in combination. Some type of direct capital investment subsidy, grant, or rebate is offered in at least 45 countries. Investment tax credits, import duty reductions, and/or other tax incentives are also common policies at national and state/provincial levels. Capital subsidies and tax credits have been particularly instrumental in supporting solar PV markets, with new solar PV rooftop programs announced in several countries in 2009. Energy production payments, sometimes called "premiums," exist in a handful of countries. Countries continue to adopt public competitive bidding for fixed quantities of renewable power capacity. And net metering laws for distributed generation now exist in at least 10 countries and in 43 U.S. states.

Policies for solar and other renewable hot water and heating were adopted with increasing frequency during 2006–2010. A growing number of countries, states, and cities mandate solar hot water in new building construction, spanning all continents and economic development levels. In Europe, a new crop of policies supporting renewable heating has emerged in recent years, such as Germany's Renewable Heating Law, which requires 20 percent minimum heating from renewables in new residential buildings. And at least 20 countries, and probably several more, provide capital grants, rebates, VAT exemptions, or investment tax credits for solar hot water/heating investments.

Mandates for blending biofuels into vehicle fuels have been enacted in at least 41 states/provinces and 24 countries at the national level. Most mandates require blending 10–15 percent ethanol with gasoline or blending 2–5 percent biodiesel with diesel fuel. Fuel-tax exemptions and production subsidies are also common. In addition, biofuels targets or plans exist in more than 10 countries and the EU. These targets call for specific shares of transport energy from biofuels (e.g., 10 percent by 2020 in the EU) or total annual biofuels production (e.g., 130 billion liters/year by 2022 in the United States).

City and local governments around the world are also enacting renewable energy promotion policies. Hundreds of cities and local governments have established future targets for renewables; urban planning that incorporates renewables into city development; building codes that mandate or promote renewables; tax credits and exemptions; purchases of renewable power or fuels for public buildings and transit; innovative electric utility policies; subsidies, grants, or loans; and many information and promotion activities.

Rural Renewable Energy

Renewable energy has an important role in providing modern energy access to the billions of people in developing countries that continue to depend on more traditional sources of energy. Some 1.5 billion people worldwide still lack access to electricity, and approximately 2.6 billion are reliant on wood, straw, charcoal, or dung for cooking their daily meals. A rural transition from traditional to more modern forms of energy is under way in households and small industries in many countries.

Renewable energy is playing a key role in this transition. In even the most remote areas, renewable energy technologies such as solar PV household systems, micro-hydro mini-grids, biogas digesters, biofuels engines, solar- and wind-powered water pumps, and solar water heaters are providing basic necessities of modern life, including lighting, cooking, communications, motive power, irrigation, water purification, and heating and cooling. Most renewable technologies can be employed in homes, schools, hospitals, agriculture, and small industry.

The number of rural households served by renewable energy is difficult to estimate, but runs into the tens of millions considering all forms of renewables. Micro-hydro configured into village-scale or county-scale mini-grids serves many of these. More than 30 million households get lighting and cooking from biogas made in household-scale digesters. An estimated 3 million households get power from small solar PV systems. Biomass cookstoves are used by 40 percent of the world's population, and a new generation of more-efficient "improved" biomass cook stoves has emerged over the years. These stoves are being manufactured in factories and workshops worldwide, and more than 160 million households now use them.

SELECTED INDICATORS AND TOP FIVE COUNTRIES

SELECTED INDICATORS	2007	2008	2009
Investment in new renewable capacity (annual)	104	130	150 billion USD
Renewables power capacity (including only small hydro)[1]	210	250	305 GW
Renewables power capacity (including all hydro)	1,085	1,150	1,230 GW
Hydropower capacity (existing, all sizes)	920	950	980 GW
Wind power capacity (existing)	94	121	159 GW
Solar PV capacity, grid-connected (existing)	7.6	13.5	21 GW
Solar PV production (annual)	3.7	6.9	10.7 GW
Solar hot water capacity (existing)	125	149	180 GWth
Ethanol production (annual)	53	69	76 billion liters
Biodiesel production (annual)	10	15	17 billion liters
Countries with policy targets	68	75	85
States/provinces/countries with feed-in policies[2]	51	64	75
States/provinces/countries with RPS policies	50	55	56
States/provinces/countries with biofuels mandates	53	55	65

TOP FIVE COUNTRIES	#1	#2	#3	#4	#5
Annual amounts for 2009					
New capacity investment	Germany	China	United States	Italy	Spain
Wind power added	China	United States	Spain	Germany	India
Solar PV added (grid-connected)	Germany	Italy	Japan	United States	Czech Republic
Solar hot water/heat added[3]	China	Germany	Turkey	Brazil	India
Ethanol production	United States	Brazil	China	Canada	France
Biodiesel production	France/Germany		United States	Brazil	Argentina
Existing capacity as of end-2009					
Renewables power capacity (including only small hydro)	China	United States	Germany	Spain	India
Renewables power capacity (including all hydro)	China	United States	Canada	Brazil	Japan
Wind power	United States	China	Germany	Spain	India
Biomass power	United States	Brazil	Germany	China	Sweden
Geothermal power	United States	Philippines	Indonesia	Mexico	Italy
Solar PV (grid-connected)	Germany	Spain	Japan	United States	Italy
Solar hot water/heat[3]	China	Turkey	Germany	Japan	Greece

Notes: Rankings are based on absolute capacities and production; per-capita rankings would be quite different for many categories. [1]Renewables power capacity figures rounded to nearest 5 GW. Renewables power capacity (including only small hydro) counts small hydro < 10 MW; this is a change from prior versions of this report. Capacity figures would be higher for other definitions of small hydro with higher limits. Excluding small hydro entirely, rounded capacity figures would be 160 GW, 195 GW, and 245 GW, for years 2007 through 2009, respectively. [2]Feed-in policies total for 2009 also includes early 2010. [3]Solar hot water/heating numbers are for 2008. 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.

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