



An IMAP
ENERGY & POWER
Report

Alternative Energy Global Report — 2010



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Skykon
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Post recession, alternative energy sector sees heightened M&A activity

In the last 12 months (LTM), M&A activity in the alternative energy sector has risen. Towards the end of 2009, acquisition activity started to recover along with output in the world's major economies. Investors and corporate buyers had seen asset values fall during the recession, and the beginnings of an economic recovery gave them more confidence to seek opportunities. The alternative energy sector saw 391 deals valued at 20.4 billion USD in the LTM ended Q2 2010, representing a strong upside of 54.8 percent in terms of transaction value (13.2 billion USD during the previous period with 389 transactions). Dollar volume in this period included one major transaction (GCL Poly/GCL Solar) which represented 3.8 billion USD or nearly 18.6 percent of total dollar volume. During the previous period, the largest transaction was the acquisition of Endesa SA-Assets by Acciona for 3.6 billion USD.

In terms of business segment, solar and wind accounted for the highest in terms of value at nearly 58 percent of total dollar volume for the period. Although wind is a relatively mature clean energy technology, there are companies developing technologies for improving performance and reliability of turbines. These enterprises continued to excite

acquisitive interest from larger industrial players. Among the more notable investments were GE's purchase of advanced drivetrain developer Scanwind and XEMC's acquisition of direct drive turbine manufacturer Darwind. Also, in early 2010, US helicopter-to-air-conditioning giant United Technologies Corporation took a 49.5 percent stake in turbine maker Clipper Windpower for 270 million USD. The deal brings large industrial corporations right into the heart of the biggest market in renewable energy, wind turbines.

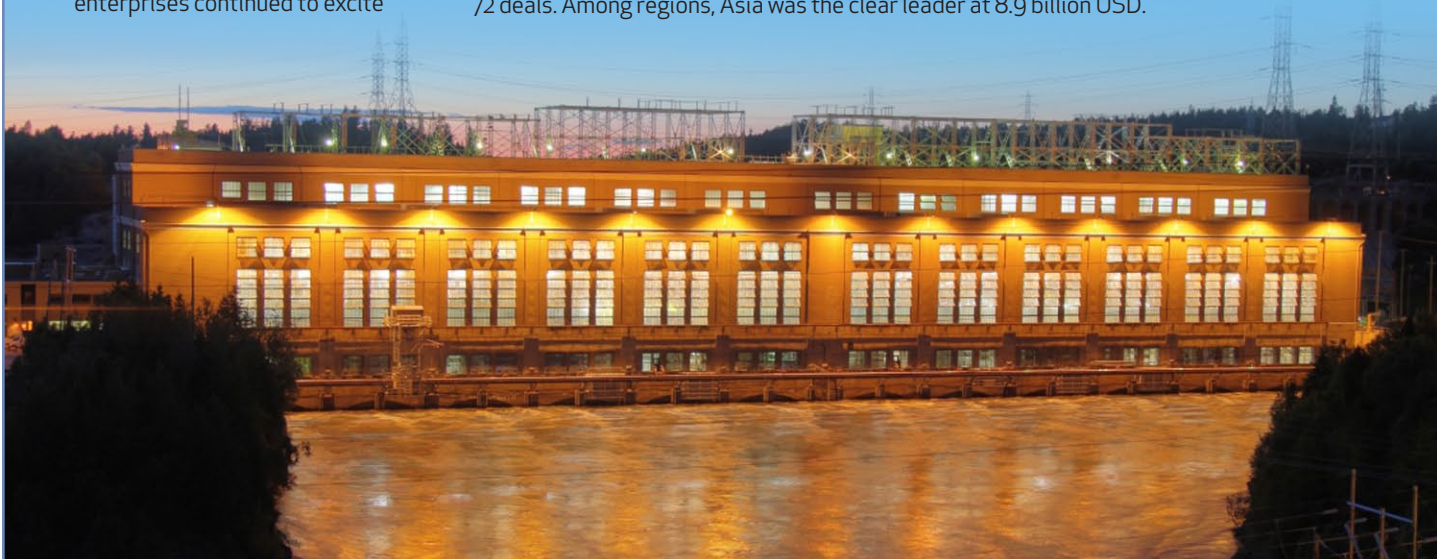
On the solar front, consolidation is beginning across the value chain. In 2009, MEMC Electronic Materials, a wafer manufacturer, carried out a 200 million USD buyout of SunEdison, an installer and owner of solar plants. This was part of a vertical integration strategy to reap larger margins from the installation and distribution of solar systems as the price of modules continued to fall. Energy Conversion Devices moved downstream with the acquisition of one of its customers, building-integrated PV systems manufacturer Solar Integrated Technologies.

In terms of geography, China saw the highest transaction value of 5.4 billion USD with a total of 23 transactions in LTM, mainly in the solar segment. The US came in second with a value of 2.6 billion USD through 72 deals. Among regions, Asia was the clear leader at 8.9 billion USD.

M&A Activities at a Glance

	LTM ending 2Q 2009	LTM ending 2Q 2010
Transaction value (USD billion)	13.2	20.4
Top 5 transactions	47.2%	34.5%
Segment	No. of transactions	Value (USD bn)
Solar	85	7.2
Wind	150	4.7
Biofuels	53	2.8
Energy Efficiency	9	2.1
Cogeneration Plants	13	1.6
Top 5 regions	No. of transactions	Value (USD bn)
Asia	63	8.9
Europe	183	6.8
North America	110	3.6
Middle East	4	0.5
South America	12	0.4
Top 5 countries	No. of transactions	Value (USD mn)
China	23	5.4
US	72	2.6
Spain	36	2.6
The Philippines	7	1.6
India	14	1.1

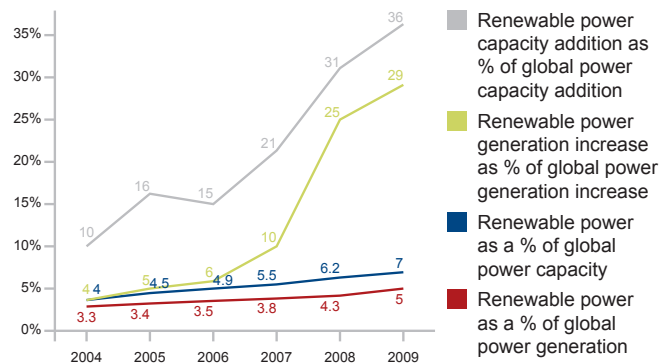
Source: Thomson M&A Database, IMAP



Alternative energy¹ that comes from sources that do not deplete natural resources, unlike fossil fuels, is increasingly gaining importance amid the unrelenting need for energy, increasing worry related to fast depleting reserves of fossil fuels and growing focus on environment protection. Renewable energy as of today represents only 5.1 percent of today's global power generation. However, it is starting to play a significant role, contributing 14 percent to growth in global power generation over the past three years.

¹ The term "renewable energy" has been used interchangeably with "alternative energy" and does not include nuclear power

Renewable power capacity growth



Source: Gartner Research, IMAP

Recession had impact on energy industry but hardly on alternative sources

In 2009, the global economic recession had a profound impact on worldwide energy demand, leading to a contraction in energy consumption by 1.1 percent globally to 484.3 quadrillion Btu (QBtu)—the first decline since 1982¹. The demand for most energy fuels, including oil, coal, natural gas and nuclear, remains sluggish, with the exception of renewable energy, including hydro power. While the performance was dull in 2009, the short term outlook is mixed, with volatility in commodity markets and positive signs of a recovery in 1H 2010. Global energy consumption is expected to reach 500 QBtu in 2010².

Despite the economic slowdown, the global alternative energy industry continued to expand rapidly in 2009. The combined revenue of the three major sources of alternative energy (i.e., solar PV, wind and biofuels) was 144.5 billion USD, increasing by 15.8 percent from 2008. Biofuels and wind power clocked growth while solar photovoltaic saw a year-on-year decline due to the steep 50 percent decrease in solar PV pricing from 2008 levels. Nevertheless, all three segments increased in capacity installation. Continued government support, including stimulus package in most countries, helped to boost global wind, solar and biofuel generation capacity by 31 percent, 47 percent and 21 percent respectively in 2009.

During 2009, renewable technologies continued to strengthen position both in terms of dollars invested and capacity installed. Including large hydro, renewable power capacity was 1,230 GW³ in 2009, comprising about 25 percent of global generating capacity (estimated at 4,800 GW) and accounting for about 18 percent of global electricity production. It is

¹ BP Statistical Review 2010, published in May 2010

² International Energy Outlook, 2010

³ Gigawatts. A gigawatt is equal to 1 million kilowatts; a kilowatt is equal to 1,000 watts.

estimated that approximately 78 GW of renewable power generation was installed globally in 2009, of which 50GW was from new alternatives and 28GW was large hydro⁴.

Apart from an increase in installed capacity growth, investment in large size (in GWs) projects were visible during the year. Some of the mega projects included:

- California-based eSolar is providing the technology and expertise for a series of concentrating solar power (CSP) towers in China, expected to total 2,000 MW⁵.
- First Solar is planning to build a 2,000 MW PV farm in Mongolia with completion expected in 2019.
- Indian wind giant Suzlon began work on a 1,000 MW farm in Dhule, India.

Additionally, energy smart technologies, which include digital energy applications, power saving applications and electric vehicles, for the first time in 2009 attracted more venture capital and private equity investment than any renewable energy technology—energy smart technologies accounted for 2.1 billion USD out of 6.8 billion USD in the sector.

Resilience was reflected in sector-wide investment which dropped marginally

Growth in investment in the alternative energy sector has been continually breaking its own record since 2004 except in the year 2009 when the sector faced the impact of the financial crisis in North America and Europe. However, the long-term

⁴ Global Trends in Sustainable Energy Investment 2010

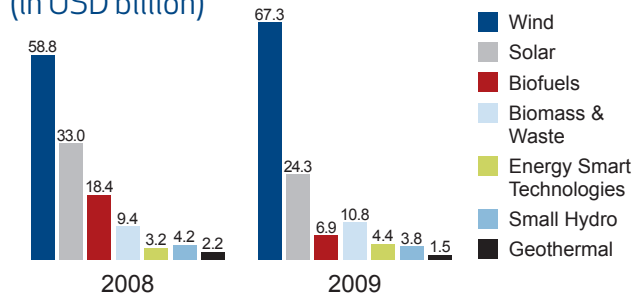
⁵ Megawatts. A megawatt is equal to 1 million watts.

growth fundamentals of the sector remained intact. New clean energy investment including R&D investment and small projects amounted to 162 billion USD¹ in 2009 (included 119 billion USD in R&D and small projects worth 43 billion USD), down by just 6.9 percent² from 174 billion USD in 2008. The decline in growth is modest because of the massive investment of 33.7 billion USD in large-scale solar and wind projects by China, up 52.5 percent up from its 2008 levels. China's investment remains quite remarkable in a scenario where most developed countries have experienced a decline in spending.

Although total investment has declined, wind remained dominant in the sector with 56 percent share in total investment amounting to 67 billion USD; this is up by 14.5 percent from 2008. Except wind and biomass, all sub-sectors experienced a decline in investment spending in 2009.

Similarly, VCs and PEs turned cautious in making investment in new firms due to a scarcity of funds along with a shortage of exit options and difficulty in raising fresh money from investors. The year 2009 witnessed a sharp decline of 42 percent from the previous year with total investment of 6.8 billion USD. The US continued to dominate the VC/PE market with 54 percent of new investment in 2009 mainly in early stage venture capital funding.

Investment (excluding R&D) by sub-sector (in USD billion)



Source: Global Trends in Sustainable Energy Investment 2010 and Bloomberg New Energy Finance, IMAP

While investors are cautious, R&D spending by governments and corporations amounted to 24.6 billion USD in 2009. The shifts reflected greater willingness by governments to invest in research on sustainable energy technologies—to help generate economic activity—and also compensate for lesser spending by the private sector.

Moving on to 1H 2010, investments of around 65 billion USD were made, increasing 22 percent from 1H 2009. However, pressure from the euro region crisis persists, which does not bode well in the near term.

¹ This figure includes investments made by VC and private equity investors; public market activity (IPOs, etc.); project financing; asset financing; government research & development; and corporate research, development, & deployment.
² Global Trends in Sustainable Energy Investment 2010

Stimulus packages and favorable regulations continue to remain a primary growth driver

Most of the leading countries extended stimulus packages towards the alternative energy sector during the recession; packages worth 184.4 billion USD are being directed on a global level, led by the US, China and South Korea whose contributions account for 76.6 percent of total stimulus packages for the sector. While the US and China are planning to spend mainly on energy efficiency, grid infrastructure deployment along with smart grid, transportation and clean vehicles, South Korea is planning to boost exports of LED lighting products, solar cells, hybrid cars and other low-carbon technology products.

According to Bloomberg Energy Finance, less than 10 percent of the funds have reached the sector in 2009. The largest chunk of the spending is scheduled for 2010 and 2011, wherein two-thirds of the funds are projected to be spent. As the global economy is coming out of the recession, governments may reconsider their spending plans and tighten national budgets, which could affect growth of the sector. Japan and Spain are considering cutting their planned clean energy expenditures.

Along with investment through stimulus plans, the establishment of the International Renewable Energy Agency (IRENA), the first and only intergovernmental agency to focus solely on renewable energy development, in January 2009 is considered as a stepping stone for the sector. IRENA has 149 signatories' countries and 30 ratified countries as of July 2010. It will function much like the International Energy Agency (IEA), collecting and analyzing statistics, providing policy suggestions, facilitating partnerships and financing across countries, promoting research and development, and creating technical codes and standards—but only for renewable energy.

Moreover, IRENA proposed a global fund for renewable energy investment, including a global feed-in tariff program, at the COP15 in Copenhagen. This proposal would enable mainly developing countries to invest on a large scale and has already attracted major interest among governments and international organizations. This program would help in kick-starting an accelerated worldwide boom in renewable energy deployment.



Stimulus package allocation schedule

Country	Amount	Sector	Amount
US	66.6	Efficiency	48.6
China	46.9	All Renewables	44.9
South Korea	27.8	Grid	36.2
EU27	12.7	R&D	28.5
Japan	8.6	Transportation	16.6
Germany	4.2	Unspecified	9.5
Australia	4.1	Total	184.4
UK	3.7		
Spain	3.6	Expected Year of Spending	Amount
France	2.7	2009	16.6
Brazil	2.5	2010	55.2
Canada	1.0	2011	64.4
Total	184.4	2012	33.5
		2013	14.7
		Total	184.4

Source: Bloomberg - New Energy Finance, IMAP

More support for alternative energy uptake to come from energy storage and smart grid

To tackle the worldwide challenges of energy security, climate change and sustainable development, alternative energy technology needs to be used and further developed. Key factors such as energy storage and smart grid along with grid parity would help to implement alternative energy on a large scale.

Commercialization of energy storage – an important milestone:

Energy storage equipment is media that can store any form of energy to be utilized at a later time. Various energy storage technologies include: pumped-hydro storage, compressed air energy storage, regenerative fuel cells, batteries, flywheels, thermal and hydrogen. On the alternative energy storage front, research on grids based on lithium ion technology is progressing rapidly. Electric vehicles and grid storage represent huge potential markets for new energy storage technologies.

Their progress can be seen through various steps undertaken by corporate houses. The GE backed company, A123 Systems, installed a 2 MW lithium ion storage unit at a California power plant. Valence Technology inked an agreement to supply its lithium ion battery systems for a new line of hybrid-electric yachts and sailboats from Beneteau Group. GS Battery teamed up with screen-printed solar-cell manufacturer Suniva to develop solar power systems with batteries that can store energy for use in peak demand periods¹.

Although R&D in the industry is making rapid strides, the technology is still expensive—10 times costlier than lead acid batteries with equivalent capacity. Nevertheless, the stimulus packages have played a big role in raising interest in energy storage technology, setting aside 2 billion USD in advanced battery manufacturing grants and up to 25 billion USD in loans for advanced vehicles, including related energy storage technologies.

¹ <http://www.renewableenergyworld.com/>

In the next 12-18 months, more energy storage technologies are likely to hit the market as several companies are now completing their evaluation period and are expected to bring down costs to a great extent.

Smart grid – an enabler of alternative energy transmission:

Grid energy storage is useful when energy production and consumption varies randomly over time. Grid storage can be made more meaningful through a smart grid, a two-way grid and network technology between supplier and consumer, which encourages consumers to modify patterns of electricity usage, including the timing and level of electricity demand. Thus, these advanced energy management techniques are useful for alternative energy commercialization because of their uneven pattern of power generation.

Alternative energy sources are by nature unpredictable—the amount of electrical energy they produce varies over time and depends significantly on factors such as the weather. Given the significant concerns regarding climate change, the need for distributed solar and wind power is critical. Integrating wind or solar power into the grid at scale—at levels higher than 20 percent²—will require advanced energy management techniques and approaches at the grid operator level.

In this regard, many regions have been taking initiatives. The US is considering smart grid to be crucial to its economic stimulus program; projects worth 1.6 billion USD were initiated in 2009 which includes digital meters in homes, distribution circuits and energy storage devices such as flywheels and batteries. The EU has an aggressive smart grid agenda with a target of 80 percent smart metering penetration by 2020. In Asia, Japan is at the forefront in implementation of smart grids with distribution automation projects. South Korea aims to have a nationwide smart grid by 2030, and Australia has started the Smart City Initiative.

As the sector comes into the limelight, emerging economies would join the race

With massive investment and rising awareness of alternative energy, the sector is attracting attention from emerging countries. The key motivation for this is the growing energy need followed by economic development through job creation and energy diversification. Some of the new developments are:

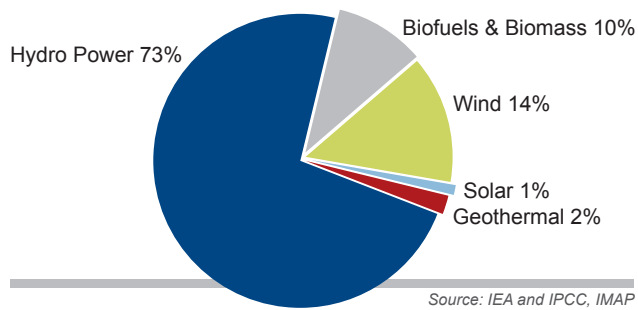
- Countries like Aruba and Serbia have finalized plans for their first utility-scale wind farms.
- While emerging countries have low installed capacity, growth remained significant in 2009. In wind power, South and Central America (excluding Brazil and Mexico) witnessed 110 percent growth and Africa (excluding Morocco and Egypt) clocked 96 percent. The increase in solar power capacity was even higher with Czech Republic clocking a massive 760 percent growth; Bulgaria, 700 percent; Israel, 600 percent; and Belgium, 411 percent.
- Eastern Europe is moving towards clean energy to reduce dependence on natural gas from Russia.

² The European Wind Energy Association

Alternative energy mix — continues to be dominated by hydro

Energy generation from alternative sources is dominated by hydro power as more than 70 percent of renewable electricity is generated from hydro sources. Further, many regions have over the years instituted adequate infrastructure for hydro power generation either as a complementary source of electricity or primary one. Hydro power is followed by biofuels, wind, solar and geothermal, with wind energy showing large potential for growth.

Renewable energy mix – 2009



Hydro power – widely used form in alternative energy mix

Hydro power generates 15-20 percent¹ of the world's electricity and accounted for about 70 percent of electricity from renewable sources. Currently, hydro electricity is generated conventionally, i.e., the gravitational force of falling or flowing water; this produces no environmental waste and emits lower levels of carbon dioxide (CO₂).

In terms of capacity, hydroelectric generation capacity increased by 1.5 percent in 2009 to 740 million tonnes of oil equivalent (MTOE) from 731 MTOE in 2008 and was the world's fastest-growing major fuel for a second consecutive year. Hydropower is currently being utilized in about 150 countries from 11,000 stations with around 27,000 generating units².

The top five countries in terms of capacity installation include China, Canada, Brazil, the US and Russia, which together constitute almost 56.7 percent of the world's installed capacity. Asia-Pacific, led by China which has commissioned significant hydropower capacity in the past two years, has the highest installed capacity at 29.2 percent of global capacity. This is followed by Europe, which holds 24.6 percent.

Going forward, China is expected to drive the development of hydro power. Europe and North America are continuing to add new capacity. In North America, more than 19 GW of development is planned, of which around 11 GW is held by Canada.

¹ BP Energy Statistical Review, 2010

² International Hydropower Association © 2010 Activity Report

Unlike conventional hydro power, non-conventional sources such as wave and tidal energy conversion systems are in the early stages of development with few technologies approaching full-scale commercial deployment. The resource opportunity is substantial with energy estimates ranging between 8,000 and 80,000 TW-h³/yr for ocean waves and greater than 800 TW-h/yr for marine currents⁴. Whilst the opportunity is enormous, the industry faces challenges such as higher costs, environmental issues and a lack of regulatory framework.

Wind continues to remain one of the high growth segments

The financial meltdown had no major impact on the wind sector worldwide. Many governments reiterated their commitment to wind energy development as many believe that this source will help contain the energy crisis. In terms of capacity, 2009 witnessed new records in wind energy utilization. Despite the global economic crisis, investment in new wind turbines exceeded those in all previous years. Wind capacity worldwide reached 160,084 MW in 2009 from 122,158 MW in 2008, 94,005 MW in 2007, 74,306 MW in 2006 and 59,398 MW in 2005. This shows that installed wind capacity is more than doubling every three years and reflects a CAGR of 28.1 percent in 2005-09.

Furthermore, the market for new wind turbines showed a 42.1 percent increase and reached an overall size of 38,312 MW in 2009⁵ after 26,969 MW in 2008, 19,808 MW in 2007 and 15,111 MW in 2006. It is worth noting that ten years ago the market size for new wind turbines was only 4,000 MW, only one-tenth that of 2009. All wind turbines installed globally by the end of 2009 contributed 340 TW-h to the worldwide electricity supply, which represents 2 percent of global electricity demand.

The turnover of the wind sector worldwide reached 63.5 billion USD in 2009, compared with 51.4 billion USD in 2008, indicating a growth of 23.5 percent and turnover is expected to reach 114.5 billion USD with an installed capacity base of 1,900,000 MW by 2019⁶.

In terms of countrywide performance, China and the US lead in terms of installed capacity, holding 38.1 percent of global wind capacity. The two countries continued to remain aggressive in terms of additional installation in 2009, accounting for 23,654 MW or 62.4 percent of total installations in 2009.

Top five countries in terms of installed wind capacity are the US, China, Germany, Spain and India.

³ Terawatt hours. A terawatt is equal to 1 trillion watts.

⁴ Ocean Energy: Global Technology Development Status, March 2009

⁵ BP Statistical Energy Overview, 2010

⁶ Clean Edge, 2010 and World Wind Energy Association

US: The US has 35,159 MW of installed wind power capacity with a 22.1 percent share in worldwide installed capacity. In light of the financial crisis, the federal government gave special incentives for investment in wind farms, and an increasing number of US states started discussing and adopting favorable legal frameworks to attract investment.

China: China increased its focus on renewable energy for the fourth consecutive year, thus becoming number one in terms of new installations in 2009 and number two in terms of total wind capacity at 25,853 MW. In 2009, Chinese wind turbine manufacturers were amongst the top five manufacturers worldwide although they did not export their products on a sizeable level (concentrating supply to the domestic market).

Germany and Spain: In terms of both total and additional capacity, Germany (25,813 MW/1,880 MW) and Spain (18,784 MW/2,241 MW) were by far the biggest markets. The additional installation growth rates were modest at 7.9 percent and 13.5 percent for Germany and Spain, respectively. The German and Spanish wind turbine manufacturing industries still outperformed in many wind markets around the world.

India: The second largest Asian market was India, with a 14 percent growth rate and reaching a total capacity of 11,000 MW. The Indian wind industry has become a global player over the past few years and is expected to expand in the next few years based on growing demand from the domestic market.

While the top five markets including China and the US could increase their share, diversification still continues and more countries are likely to deploy wind energy on a larger scale. By the end of 2009, 17 countries had installations of more than 1,000 MW compared with 16 countries at the end of 2008.

Solar PV remains a potential high growth segment

Unlike most alternative energy sources, solar PV has become a proven, commercialized energy source. Moreover, government incentives, advancements in technology and most importantly price declines are rapidly altering the solar industry landscape. Installed solar PV capacity reached 22,929 MW in 2009, significantly up by 46.9 percent from 2008 and recorded a sound 40 percent CAGR since 2000.

Furthermore, prices of crystalline silicon modules and installation cost reduced around 30–50 percent in 2009, tremendously benefiting the industry. This decrease in prices was led by cheaper silicon availability, an increase in production capacity and price competition. It also contributed to the emergence of China as a leading PV cell manufacturer, which keeps prices competitive because of its low-cost production infrastructure.

With significant changes in the industry landscape, solar PV (including modules, system components and installations) will grow from a 36.1 billion USD industry in 2009 to 116.5 billion USD by 2019¹, indicating a CAGR of 12.4 percent.

In terms of geography, Europe dominates the PV market with Germany and Spain together holding 57.1 percent of the global installed capacity.

Top five countries in terms of installed solar capacity are Germany, Spain, Japan, the US and Italy.

In Europe, Germany remains the world's largest PV market with a cumulative installed PV capacity of 9,677 MW, including around 3,800 MW installed in 2009. After installation of remarkable amount of capacity in 2008, Spain was passive in 2009. In the mid-term, Italy appears to be a promising market with 711 MW added to its existing capacity in 2009.

Outside Europe, Japan and the US are leading markets, with Japan as the third largest market at 2,628 MW; Japan also shows strong potential due to favorable political support. The US' existing capacity is 1,645 MW with new addition of 475 MW in 2009; it should be a high growth market in the years to come. The entry of Canada and Australia in the PV market shows that the global PV market is expanding its boundaries.

On the emerging market front, China and India are expected to witness a surge in the next five years due to a strong project pipeline. A major PV manufacturer, China with more than

¹ Clean Edge

12,000 MW of large projects underway can rapidly become a major market in the world. India has a diversified PV industry consisting of vertically integrated manufacturers making solar cells, solar panels and PV systems. Starting from 30 MW in 2009, the market could grow to 1,500 MW in 2014.

Thus, solar energy is becoming increasingly affordable. Falling prices can threaten profitability across the value chain—from manufacturer to installer. As the industry matures and solar prices keep falling, more consolidation across the value chain and increased commoditization of solar technology can be expected.

Geothermal power – potential undiscovered

Geothermal power is generated from heat within the earth, which is formed and stored as a result of the original formation of the planet. Currently, a small fraction of the world's geothermal resources has been developed and abundant resources are available beneath the earth which can generate an enormous amount of geothermal energy¹.

By the end of 2009, worldwide installed capacity was 10,710 MW and electricity generation was 67,246 GW-h², indicating a 3.9 percent growth from 2008 and a CAGR of 4.3 percent from 2005 to 2009. With the development of low-temperature power and enhanced geothermal system technologies, the geothermal market appears to be expanding gradually. It is expected to grow to 18,500 MW by 2015³.

The Americas account for the largest installed capacity with key nations being the US and Mexico. The US, with 3,086 MW of installed geothermal capacity, is a leader in geothermal installed capacity. Mexico, with 958 MW of geothermal energy on line, ranks fourth globally. Europe had 24 countries with geothermal projects under development in 2009 with the support of the European Bank for Reconstruction and Development. Geothermal energy is a key resource for African countries along the East African Rift Valley System, a volcanic

¹ Wikipedia

² Gigawatt hours.

³ International Geothermal Association (IGA)

region with an estimated 7,000 MW of electricity-generating potential. Six African countries were active in geothermal power in 2007, growing to 11 countries in 2009.

Biofuels – industry transition to next generation biofuels

Biofuels are a wide range of fuels which include solid biomass, liquid fuels and biogases. All together, biofuels provided 1.8 percent of the world's transport fuel in 2009.

In terms of production, the biofuels market produced 19.5 billion gallons of ethanol and around 4 billion gallons of biodiesel worldwide in 2009. The biofuels market reached 44.9 billion USD in 2009, up by 29 percent from 2008, and is projected to grow to 112.5 billion USD by 2019⁴. Further, the share of ethanol in global gasoline type fuel is increasing dramatically, from 3.78 percent in 2007 to 5.46 percent in 2008 whereas the share of biodiesel in global diesel type fuel climbed from 0.93 percent to 1.5 percent during the same period⁵.

The main producing regions for transport biofuels are the US, Brazil and the EU. Ethanol production is highly concentrated as the US and Brazil accounted for more than 85 percent of the world's production in 2009.

Production consists mostly of ethanol from corn in the US and sugar cane in Brazil, and biodiesel from rapeseed in the EU. Ethanol production grew 8.1 percent in 2009 wherein most of the incremental growth came from the US. These countries have flex-fuel vehicles which can run on 100 percent ethanol as fuel.

The biofuel industry is on the verge of a major breakthrough in which fuels will be made from grasses and other fibrous or cellulosic crops, providing high volumes of energy from small areas of land. In terms of usage, the industry continues to pursue new and expanded uses for biofuels as an aviation fuel beyond E10⁶, mid-level blends and E-85⁷, as well as a fuel source for hydrogen fuel cells.

⁴ Clean Energy Trends 2010

⁵ Towards Sustainable Production and Use of Resources: Assessing Biofuels, UNEP, October 2009

⁶ E10 is a blend of 10% anhydrous ethanol and 90% gasoline.

⁷ E85 is a blend of 85% anhydrous ethanol and 15% gasoline.



Hot investment opportunities

In addition to traditional drivers such as climate change, energy insecurity, fossil fuel depletion and new technologies, demand for alternative energy is receiving a boost from mandates including renewable portfolio standards, renewable fuel standards, building codes and efficiency regulations. These give an impetus to various trends such as digital energy, hydrogen storage systems, CCS (CO₂ capture and storage) and implementation of nanotechnology for generating alternative energy.

Digital energy – the next generation phase

Digital energy is the conjunction of traditional energy, telecom and IT. Control is switching from analog to digital, and data is becoming pervasive throughout the system which goes beyond the current network optimization of grids. There will be new types of data to manage—data on carbon footprints, liberalized pricing, resources and usage patterns. In addition, the cost of sensors and communications is likely to drop dramatically over the years. Thus, in the next 10-20 years, the global energy infrastructure is expected to undergo a major transformation.

While the prospects of digital energy are bright, the industry, regulators and policy makers are not yet ready to grapple with the implications of moving to a new era. That said, some players are making active efforts to take advantage of digital energy.

Next step evolution of energy storage is hydrogen

Hydrogen is not a primary energy source but is an energy carrier (similar to electricity) and can store and deliver energy in a widely usable form; it is also the most promising alternative fuel for future transport applications. It is expected that hydrogen will be key to sustainable energy storage going forward, particularly in regions where grid transmission is unreliable for alternative energy. It is even likely that hydrogen will provide better energy storage solutions with greater versatility and economic benefit than compressed air storage and pumped hydro systems. However, significant development is needed before hydrogen can be exploited in the same way as conventional fossil fuels.

Hydrogen generation, storage and delivery in the US and European markets is estimated at 2 billion USD¹ and is expected to grow at an average annual rate of 15 percent in the next two to three years.

CO₂ capture and storage (CCS) is gaining a foothold

CO₂ emissions from the energy sector are likely to increase by 130 percent from 2005 levels by 2050² in the absence of new policies or initiatives. CCS is the only technology available to mitigate greenhouse gas emissions from large-

scale fossil fuel usage in fuel transformation, industry and power generation. Thus, CCS has strong potential and the industry already boasts of a few startups such as Carbon Capture, Calera, Carbon Sciences, Carbon8 Systems, Novomer, Raytheon, Accelergy and Solix Biofuels.

However, for the CCS technology to be viable, associated costs need to be lowered and the technology needs to be demonstrated on a commercial scale. Additional R&D is also needed, particularly to address different CO₂ streams from industrial sources and to test biomass and hydrogen production with CCS.

New breed of biofuels being developed to prevent energy imbalance

Global production of first generation biofuels, produced from food crops and vegetable oils, has been increasing rapidly. However, the expanding biofuel industry has recently raised important concerns such as effects on the environment, displacement of food crops, deforestation and climate change. Further, higher biofuel demand in the US and the EU has led to a more than twofold increase in prices of corn and soybean along with livestock feed in the last two years.

Hence, next-generation biofuels, produced from algae and non-food plants are emerging as a potentially viable alternative to conventional biofuels. These biofuels are not commercialized currently and extensive R&D activities on second-generation biofuels are underway, which is estimated to take at least a decade to become fully operational. Going forward, it is expected that second-generation biofuels will account for roughly 90 percent of all biofuel production by 2050³ with China and India accounting for 19 percent of total production.

Nanotechnology

Nanotechnology is a field of applied science involved in the control of matter on an atomic and molecular scale. This technology provides significant potential to enhance energy efficiency in the area of alternative energy through optimized production technologies. It is expected that nanotechnological innovations will be applied in the entire value chain of the energy sector starting from generation to distribution and usage. Nanotechnology is likely to be commercialized in the medium to long term.

¹ www.futureenergies.com

² Energy Technology Perspectives 2008 (ETP)

³ Estimate by Energy Technology Perspectives 2008

Threat to alternative energy investment – growth is noteworthy, quantum is less

Despite the relative resilience of the alternative energy sector in 2009 compared with fossil fuels, it still contributes little to global power generation (i.e., less as 5 percent). This small fraction of power generation from alternative sources is also, to a great extent, a result of public policy and government support. Without grant programs, a national target or a price on carbon, the sector is less attractive to investors. Further, government grants are highly dependent on the geopolitical and macroeconomic environments, which are major risk factors in this volatile global economic market.

In brief, energy generated from alternative sources is in the nascent stage and cannot be meaningfully compared with fossil fuels. To compete with fossil fuels, the alternative energy sector needs massive capital investment and longer implementation periods for rollouts. Alternative energy sources such as wind, solar and geothermal power require millions of electric vehicles to compete against the current fossil fuel-based-generated electricity. Though alternative energy is a necessary phenomenon to alleviate concerns of energy insecurity and environmental degradation, it will still be some time before a large scale roll-out is witnessed.

In 2010, the sector is facing challenges as the second phase of the economic downturn began in Europe, with several governments running a fiscal deficit and markets exhibiting volatility. A weak Euro, cuts in government spending and subsidy, and severe competition from China and India cloud the outlook for the alternative energy investment market in Europe.

For example, Germany reduced subsidies to new solar plants by as much as 16 percent, creating more adversities for the high cost German solar energy industry. In Italy, new wind and solar energy power generation plants are expected to reduce capacity by 10 to 20 percent by the end of 2010. Spain, the biggest country in the EU region in terms of renewable investment, is expected to cut the size of its renewable energy subsidies by about 30 percent. Outside Europe, the US might see a decline in wind installation by as much as 40 percent.

Furthermore, most renewable energy indices are consistently posting negative returns in the range of 3-10 percent and investors are taking a backseat considering the bleak outlook of the sector.

Future Outlook

The year 2009 was not successful in terms of developed and developing nations reaching an agreement in Copenhagen. The absence of a consensus dampened the hopes of climate being the main driver of alternative energy investments. Moreover, the likelihood of US federal cap-and-trade legislation diminished significantly with the inability of countries to arrive at a global climate accord.

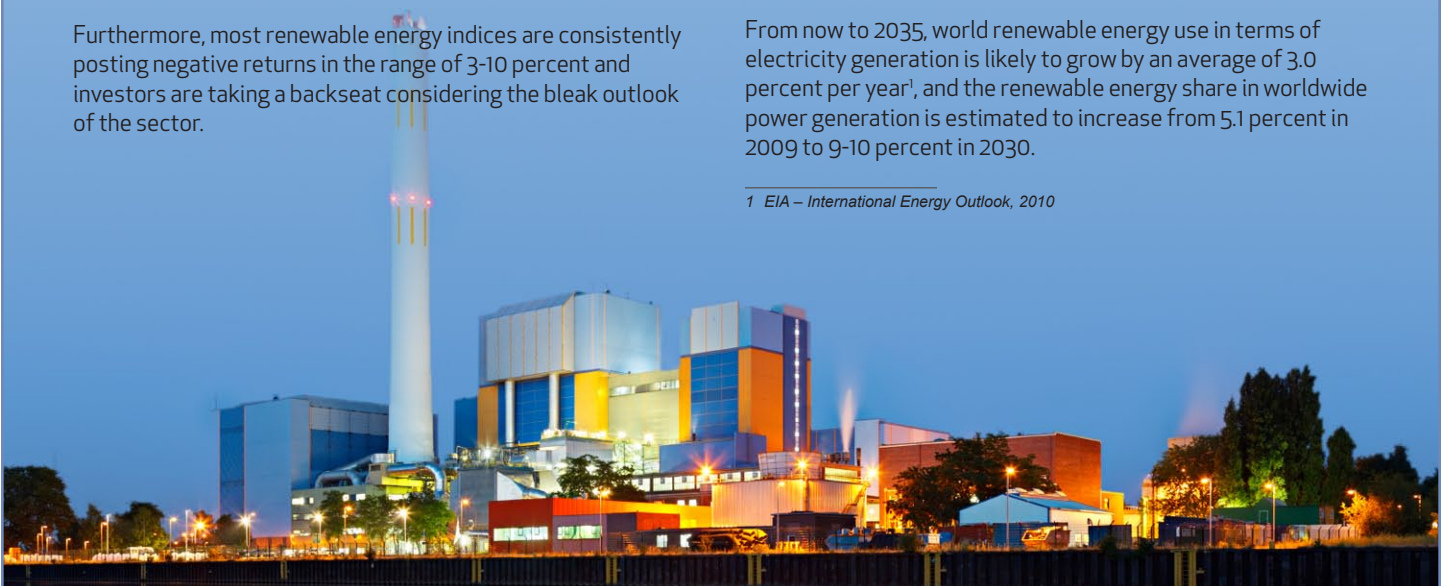
Despite this setback, the long term outlook can be still seen as bright. In the future, energy demand growth will be largely concentrated in developing economies due to the unrelenting demand in these regions. Hence, there is high potential for renewable energies in these markets. Conventional forms of energy will still dominate. However, emerging markets are rapidly expanding their power generation capacity, and it is likely that this additional capacity could partly be contributed by wind, solar, bio and hydropower. With governments having a long term goal of a low carbon world, investments are bound to improve.

While investments may seem on the low side at present, the cost of clean energy technologies is falling and these technologies are making their presence felt in many applications. Major growth is likely to come from the commoditization of solar PV installations, smart meters, energy storage devices, wind turbines and other clean technologies. Some examples are roof tiles from Dow Chemicals integrated with solar PV installations or washing machines from GE embedded with smart devices that can “communicate” with grid operators. With commoditization in the coming decade, we can expect the market to start maturing—leading to consolidation, with multinationals and pure plays acquiring smaller companies to increase market share and stay competitive.

Industry experts estimate that the installed price for solar PV installations will drop nearly 60 percent from an average of 5.12 USD per peak watt in 2009 to 1.11 USD per peak watt in 2019. Installed wind turbine pricing, which declined 11.1 percent from 1.9 USD million per MW installed in 2008 to 1.7 USD million per MW installed in 2009 is now competitive even with limited or no subsidies.

From now to 2035, world renewable energy use in terms of electricity generation is likely to grow by an average of 3.0 percent per year¹, and the renewable energy share in worldwide power generation is estimated to increase from 5.1 percent in 2009 to 9-10 percent in 2030.

¹ EIA – International Energy Outlook, 2010



Appendix A: Global Overview of Alternative Energy

Definition of Alternative Energy

- Alternative energy is a broad-based term that covers all sources of usable energy that can replace fuel sources in a clean manner. Oxford Dictionary defines it as energy fuelled in ways that do not use up natural resources or harm the environment.
- Alternative fuels, also referred to as non-conventional or advanced fuels, are the entire range of materials that can be used as fuels, except conventional fuels. Conventional fuels include fossil fuels (petroleum (oil), coal, propane, natural gas and nuclear materials such as uranium).
- Various benefits of alternative energy include environment-friendliness, price stability of sources and renewable and local production. One of the most important benefits of alternative energy is that it is the least polluting to the environment compared with conventional sources of energy.

Business classification of alternative energy

The worldwide alternative energy market is composed of the following submarkets:

- Wind power: Onshore and offshore wind power sources including windmills, distributed power windmills, Nano Vent-Skin, floating platform wind farms and airborne wind energy systems
- Solar photovoltaic (PV): solar panels, concentrated solar arrays, solar molten salt energy storage and nanotechnology applications in solar power
- Water systems: geothermal, hydroelectric, wave, tidal, water conservation and desalinization
- Biomass: waste-to-energy, waste methane and biofuels such as biodiesel and ethanol; cellulosic ethanol; biomass fuels (includes miscanthus, jatropha switchgrass, hemp, corn, poplar, willow, sorghum & sugarcane, algae, and halophytes)
- Fuel cells: phosphoric acid fuel cells (PAFC), molten carbonate fuel cells (MCFC), solid oxide fuel cells (SOFC), proton exchange membrane fuel cells (PEMFC), nanotechnology fuel cells and titanium separator based fuel cells

Of the above, solar PV, wind power and biofuels are the major sources of alternative energy which have been widely commercialized. Except for these three sources, most renewable generation technologies are not economically competitive or have limited application. Mostly, government incentives or policies provide the primary support for construction of renewable generation facilities. In any case, the utilization of these alternative sources is expected to increase at a rapid rate in the coming years.

Global energy sector – overview and trends

- The global economic recession that began in 2007 and continued into 2009 had a profound impact on worldwide energy demand. Total marketed energy consumption globally contracted by 1.2

percent in 2008 and by 1.1 percent in 2009, to 484.3 quadrillion Btu—the first decline since 1982¹ — as manufacturing and consumer demand for goods and services declined. The decrease in energy consumption was concentrated in OECD countries and the territory of the former Soviet Union (FSU)².

- Consumption of oil, natural gas and nuclear power fell, while coal consumption was flat; only that of hydroelectric output and other renewable forms of energy increased in 2009. The data suggests global CO2 emissions from energy use fell for the first time since 1998.

With consumption declining, energy prices decreased in 2009, though this trend varied depending on the type of fuel. Oil prices were below \$40 per barrel at the beginning of the year and increased steadily as OPEC's production cuts exceeded the decline in consumption. Natural gas prices in competitive markets fell sharply and remained weak through most of the year due to falling consumption and continued development of unconventional resources in the US. Coal prices fell as well and then started to recover, again exhibiting varying behavior according to region. China was a high coal importer, which helped prevent global coal consumption from falling³.

Demand Supply Dynamics for Other Fuels:

- Global coal consumption was flat in 2009, the lowest yearly change since 1999. The OECD (-10.4 percent) and FSU (-13.3 percent) saw the sharpest consumption declines on account of a combination of recession and competitively priced natural gas. Consumption fell in all regions except Asia-Pacific and the Middle East.
- Global nuclear output fell by 1.3 percent, a third consecutive global decline.
- Hydroelectric generation increased by 1.5 percent, which is below the average; this made hydro the fastest-growing major fuel globally in 2009. Growth was led by China, Brazil and the US.
- While other forms of renewable energy hold a small share of the global energy mix, they have continued to grow at a rapid pace. Continued government support, including targeted fiscal stimuli in many countries, helped to boost global wind and solar generation capacity by 31 percent and 47 percent respectively. Wind growth was led by China and the US, which accounted for a combined 62.4 percent of total growth. Ethanol production rose by 8.1 percent, just over half the historical average; continued robust growth in the US (52.9 percent of global ethanol supply) was partly offset by a decline in Brazil (33.9 percent of worldwide output).

Going forward, global energy consumption is expected to reach 738.7 quadrillion Btu by 2035, representing a CAGR of 1.5 percent.

¹ BP Statistical Review 2010, published in May 2010

² International Energy Outlook (IEO) 2010

³ BP Statistical Review 2010, published in May 2010

Comparative overview of business value chain of various alternative energy sources*

Traditional Energy Players	Hydro Power	Solar Energy	Wind Energy	Biomass/Ethanol Energy
Energy Commodity	Water storage	Silicon Supply	Technical Feasibility	Forming
Generation	Dam construction	Wafer Manufacturing	Wind Turbine Manufacturing	Planting
Transmission	Generation	Cell Manufacturing	Wind Farm Construction	Harvesting
Distribution	Transmission	PV Module Manufacturing	Generation	Crushing/Fermentation, Distillation
Energy Services (Retail)	Distribution	PV System Manufacturing	Transmission	Marketing
Electric Devices & Appliances	End Users	Project Development	Distribution	Distribution
End Users		End Users	End Users	End Users

* <http://www.solwafer.eu>, <http://www.umoebioenergy.no>, <http://www.impsa.com>

Global alternative energy sector – overview and trends

- Global revenue for solar photovoltaic (PV) installations, wind power and biofuels in 2009 expanded by 15.8 percent over the previous year, reaching \$144.5 billion USD. All three sectors saw an increase in total deployment, with increased revenue for both biofuels and wind power. Solar, however, saw its first year-on-year decline in total revenue since 2000 due to a downward slide in solar PV pricing.
- Renewable energy sector withstands the global financial crisis: Recovering from a hard fall in the first quarter of 2009, worldwide clean energy investments reached an impressive \$162 billion USD in 2009, down 6.6 percent compared with 2008. The clean energy sector fared better than the oil and gas industry, which witnessed a 19 percent contraction in investment according to the International Energy Agency's (IEA) 2010 World Energy Outlook.
- Stimulus funds – countrywide spending initiatives: Under global stimulus plans, \$184 billion USD is being directed towards clean energy, led by the US (\$67 billion USD) and China (\$47 billion USD). Less than 10 percent of these funds reached the sector in 2009 while in 2010, 30 percent of funding is expected to reach the sector¹.
 - While most of the stimulus money has been allocated in the US and China, majority of the funds has been spent by South Korea (20 percent) and the US (12 percent).
 - Two-thirds of stimulus funds related to renewable energy is projected to be spent during 2010 and 2011. According to industry estimates—the largest chunk of spending is scheduled for 2011 (31 percent).
 - As the global economy comes out of the recession, governments are reconsidering spending plans and tightening national budgets. Japan and Spain, for example, may cut planned clean energy expenditures.
 - The US has allocated stimulus funding for energy efficiency, renewable energy deployment, transportation and smart grid technology.
 - China plans to spend \$46.8 billion USD on energy efficiency, clean vehicles, grid infrastructure and other clean energy technology. It has announced the “Golden Sun” initiative, which aims to fund up to 50 percent of the installation cost of PV power plants in China.
 - The Korean government intends to hike its share in the overseas clean energy market by allocating stimulus funds to boost exports of LED lighting products, solar cells, hybrid cars and other low-carbon technology products.
- Positive regulatory policy: The International Renewable Energy Agency (IRENA) is an intergovernmental organization for promoting the adoption of renewable energy worldwide. It aims to provide concrete policy advice and facilitate capacity building and technology transfer. IRENA was formed on January 26, 2009, by 75 countries signing the charter of IRENA. As of March 2010, IRENA has 143 member states whereby all are considered as founding members; 14 among them have also ratified the statute.
- Favorable renewable energy mega-projects see advantages as well as challenges: Contrary to the conventional view that clean tech cannot operate on a large scale, projects of unprecedented size in wind, solar, smart grid and urban design are functioning successfully around the globe.
 - Many projects have seen their plans getting delayed, scaled back or scrapped altogether; this reflects the challenge of transforming a fossil fuel based economy into a cleaner one. These clean-tech mega-projects carry high financial and logistical risks, with many of them failing in 2009 often on account of the economic recession. Several new deployments are generating energy from single-location wind and solar projects in the gigawatt (GW) range. Many of these projects are blooming in China.
 - The situation for renewable energy looks much less ambiguous as renewable electricity sources such as wind, solar and geothermal power requires millions of electric vehicles to substitute the current fossil fuel based generated electricity. This roll-out will require many years and massive capital expenditure.

¹ Clean Energy Trends, 2010

Global alternative energy consumption by end-user sector²

- The industrial sector³ uses more energy globally than any other sector, consuming about 50 percent of total energy. Worldwide industrial energy consumption is expected to grow from 184 quadrillion Btu in 2007 to 262 quadrillion Btu in 2035. Renewable energy use constitutes a substantial portion of the world's industrial sector energy consumption. In 2007, the industrial sector consumed 13 quadrillion Btu of electricity from renewable energy, or about 7 percent of the sector's total energy use. Biomass for heat and power production currently provides the majority of renewable energy consumed in the industrial sector (90 percent), and it is expected to remain the largest component of the sector's renewable energy mix through the forecast period.
- The transportation sector⁴ is second only to the industrial sector in terms of total end-use energy consumption with 30 percent of the world's total energy consumption, most of which is in the form of liquid fuels, hence, this sector does not consume much renewable energy as a nature of business. Non-OECD energy use for transportation increased by 7.3 percent in 2008 and by about 3.2 percent in 2009. With the economic recovery expected to continue in China, India and other non-OECD nations, growing demand for raw materials, manufactured goods, and business and personal travel is projected to support the high growth in energy use for transportation both in the short and long term. In the IEO2010 Reference case, non-OECD transportation energy is likely to increase at a CAGR of 2.6 percent from 2007 to 2035.
 - Compared with non-OECD economies, high oil prices and the economic recession had a greater impact on OECD economies. OECD energy use for transportation declined by an estimated 1.3 percent in 2008, followed by a further decrease of about 2.0 percent in 2009. Given that economic recovery in OECD countries is likely to be slower, return to growth in transportation energy use in these regions will not begin before late 2010. Considering that OECD transportation energy use will grow by only 0.3 percent per year till 2035, usage levels are not likely to return to 2007 levels until after 2020.
 - In the long term, for both non-OECD and OECD economies, steadily increasing demand for personal travel is a primary factor underlying the forecasted increase in energy demand for transportation.
- The buildings sector comprising residential⁵ and commercial⁶ accounts for about one-fifth of the world's total energy consumption. Typical households in OECD nations use more energy than those in non-OECD nations, because higher income levels in the OECD nations support purchases of larger homes and more energy-intensive equipment. In the IEO2010 Reference case, world residential energy use would increase by 1.1 percent per year, from 50 quadrillion Btu in 2007 to 69 quadrillion Btu in 2035. Non-OECD residential energy consumption is expected to rise by 1.9 percent per year, compared with the marginal rate of 0.4 percent per year for OECD countries. This is because in these countries patterns of residential energy use are well established and slower population growth and aging populations translate to smaller increases in energy demand.
 - OECD commercial energy use is estimated to expand by 0.9 percent per year in the IEO2010 Reference case. Among non-OECD nations, economic activity and commerce are likely to increase rapidly from 2007 to 2035 at CAGR of 2.7 percent, indicating the increasing need for energy required for the growing education, healthcare and social services sectors.

² International Energy Outlook (IEO), 2010

³ Energy is consumed in the industrial sector by manufacturing, agriculture, mining and construction as well as for a wide range of activities such as processing and assembly, space conditioning and lighting.

⁴ Energy use in the transportation sector includes energy consumed in moving people and goods by road, rail, air, water and pipelines.

⁵ In the residential sector, energy use is defined as the energy consumed by households, excluding transportation uses.

⁶ The commercial sector referred to as the services sector or the services and institutional sector consists of businesses, institutions and organizations that provide services.

Thumbnail summaries of top 50 alternative energy companies

1: Energias de Portugal SA (Portugal)

Brief description	Generates, supplies and distributes electricity and supplies and distributes gas. Operates through the following business units: electricity generation, renewable energies, electricity distribution, electricity supply and gas.
Products sold	Electricity generation, transmission and distribution and natural gas distribution
Financials (LTM)	Revenue: \$17.6 billion USD, year-over-year change: (10.8%) Operating profit: \$2.8 billion USD, year-over-year change: 3.8% Net income: \$1.5 billion USD, year-over-year change: (6.2%)
Expected capital expenditure (2010)	\$4 billion USD
Geographic coverage (2009)	Portugal: 62%; Spain: 22%; Brazil:12%; Europe: 3%; US: 1%
Future plans	New hydro plants (1.7GW) are under construction and would be operational by 2012-15; , inefficient old hydro plants would be shut down.

2: Centrais Eletricas Brasileiras SA (Brazil)

Brief description	Engaged in the nuclear, hydroelectric and fossil fuel electric power industry. Specializes in the development, financing, construction and operation of electric power plants as well as generation, transmission and distribution of electric power.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$13.4 billion USD, year-over-year change: (12.2%) Operating profit: \$2.3 billion USD, year-over-year change: (36.9%) Net income: \$0.3 billion USD, year-over-year change: (97.2%)
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Brazil:100%
Future plans	Undertake cost cutting measures, rebuild the strategy after government election

3: Vestas Wind Systems A/S (Denmark)

Brief description	Develops, manufactures, markets, distributes and markets wind power systems that use wind energy to generate electricity. Operates internationally through a network of subsidiaries.
Products sold	Products include supervisory control and data acquisition systems and wind power systems. Services include land and offshore wind turbine installation, service and maintenance of wind power systems, wind power projects planning and consulting services
Financials (LTM)	Revenue: \$8.9 billion USD, year-over-year change: 10.0% Operating profit: \$0.9 billion USD, year-over-year change: 28.1% Net income: \$0.6 billion USD, year-over-year change: 13.1%
Expected capital expenditure (2010)	\$1.0 billion USD
Geographic coverage (2009)	Europe: 68%; Americas: 21%; Asia-Pacific: 11%
Future plans	Additional recruitment for fulfilling US orders and expand capacity

4: Companhia Energetica Minas Gerais - CEMIG (Brazil)

Brief description	Generates, transmits and distributes electric energy for industrial, residential, commercial and rural consumption. Operates 65 hydroelectric, thermal and wind plants, with a combined capacity of 6,716 GW. Present in 13 Brazilian states and also in Chile.
Products sold	Electricity generation, transmission, and distribution; energy trading
Financials (LTM)	Revenue: \$6.5 billion USD, year-over-year change: 7.5% Operating profit: \$1.7 billion USD, year-over-year change: 1.7% Net income: \$1.1 billion USD, year-over-year change: (1.4%)
Expected capital expenditure (2010)	\$1.8 billion USD
Geographic coverage (2009)	Brazil: 100%
Future plans	Capacity expansion through the acquisition of TAESA

5: Doosan Heavy Industry & Construction Company (South Korea)

Brief description	Manufactures reactor vessels, reactor internals, steam generators and peripheral systems; boilers and material handling equipment for nuclear power plants, desalination systems, stevedoring facilities; handling equipment and other heavy engineering goods.
Products sold	Nuclear power plant products, power plant products
Financials (LTM)	Revenue: \$4.9 billion USD, year-over-year change: (10.0%) Operating profit: \$0.3 billion USD, year-over-year change: (14.9%) Net loss: \$0.3 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$1.5 billion USD
Geographic coverage (2009)	South Korea: 39%; Middle East: 26%; Asia: 25%; Rest of the world: 10%
Future plans	Raise funds through the IPO of Doosan Engines and maintain an inventory standard for future orders

6: Verbund (Oesterreichische Elektrizität AG) (Austria)

Brief description	Generates, transmits, sells and distributes electricity in Austria, Slovenia, Italy, Poland and Germany. Operates 116 power plants which include 88 hydropower plants, 8 thermal power plants and 20 procurement rights hydropower plants. Generates 86% of electricity from hydropower.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$4.8 billion USD, year-over-year change: (7.0%) Operating profit: \$1.4 billion USD, year-over-year change: (5.7%) Net income: \$0.8 billion USD, year-over-year change: (6.2%)
Expected capital expenditure (2010)	\$0.7 billion USD
Geographic coverage (2009)	Austria: 50%; Rest of the world: 50%
Future plans	Focus on expanding operations in Russia

7: Gamesa Corporación Tecnológica SA (Spain)

Brief description	Promotes, constructs and sells wind parks along with the engineering, design, manufacturing and sale of wind turbines. Operates through its various subsidiaries and is a 14.5%-owned affiliate of Iberdrola SA.
Products sold	Products include wind turbines and wind power components; services include promotion, construction and sale of wind farms
Financials (LTM)	Revenue: \$4.4 billion USD, year-over-year change: (12.6%) Operating profit: \$0.2 billion USD, year-over-year change: (14.9%) Net income: \$0.1 billion USD, year-over-year change: (64.2%)
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Europe (excluding Spain): 33%; Spain: 31%; US: 18%; China: 7%; Rest of the world: 11%
Future plans	Improve performance of its wind farm division and cut operating cost up to 5% from 2009 levels

8: Suzlon Energy (India)

Brief description	Manufactures wind turbine generators of various capacities and its components. Other operations include sale/sub-lease of land, infrastructure development income, sale of gear boxes, sales of foundry and forging components and power generation. Acquired a 37.82% interest in REpower Systems AG in 2009.
Products sold	Products include wind turbine generators, gearboxes, nacelle covers, rotor blades, foundry and forging parts; services include wind energy solutions, i.e. installation services, operation and maintenance services, site identification and development, and wind resource mapping
Financials (LTM)	Revenue: \$4.3 billion USD, year-over-year change: (20.9%) Operating profit: \$0.05 billion USD, year-over-year change: (89.8%) Net loss: \$0.2 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.2 billion USD
Geographic coverage (2009)	Europe: 32%; US: 28%; India: 17%; Australia & New Zealand: 11%; China: 5%; Rest of the world: 6%
Future plans	Financial restructuring and increasing operational efficiency

9: Empresa Nacional de Electricidad S.A. - Endesa (Chile)

Brief description	Generates and distributes electric energy through 29 generation facilities in Chile with an aggregate installed capacity of 5,650 MW. Of the total installed capacity, 61.3% is hydroelectric, 37.3% is thermoelectric and 1.4% is from wind power.
Products sold	Electricity generation, transmission and distribution; gas transportation
Financials (LTM)	Revenue: \$4.3 billion USD, year-over-year change: (4.6%) Operating profit: \$1.7 billion USD, year-over-year change: 16.3% Net income: \$1.0 billion USD, year-over-year change: (44.8%)
Expected capital expenditure (2010)	\$0.4 billion USD
Geographic coverage (2009)	Chile: 100%
Future plans	Resolve issues around new project development, such as stringent environmental legislation

10: British Columbia Hydro & Power Authority (Canada)

Brief description	Owns and operates electric generation and distribution facilities in the province of British Columbia. Operates 31 hydroelectric facilities and 3 thermal generating plants with an installed capacity of 11,300 MW.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$3.6 billion USD, year-over-year change: 4.4% Operating profit: \$0.2 billion USD, year-over-year change: 8.0% Net income: \$0.3 billion USD, year-over-year change: 8.0%
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Canada: 100%
Future plans	NA

11: RusGidro OAO (Russia)

Brief description	Generates power from renewable energy sources—flowing water, tidal, wind and geothermal. Also transmits and distributes electric energy on the wholesale market. Has installed capacity of 25.3 GW and is owned by the Federal Agency for State Property Management which has a 60.38% stake.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$3.7 billion USD, year-over-year change: 7.4% Operating profit: \$1.2 billion USD, year-over-year change: NM Net income: \$0.9 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$2.5 billion USD
Geographic coverage (2009)	Russia: 100%
Future plans	Aggressive M&A strategy and gradual improvement in capacity

12: Companhia Paranaense de Energia - COPEL (Brazil)

Brief description	Runs 18 power plants of which 17 are hydroelectric. Transmission system totals 1,942 kilometers of lines and 30 substations which serves 3,628,183 consuming units across 393 cities and 1,109 locations in the state of Parana.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$3.1 billion USD, year-over-year change: 2.9% Operating profit: \$0.7 billion USD, year-over-year change: (6.8%) Net income: \$0.5 billion USD, year-over-year change: (4.8%)
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Brazil: 100%
Future plans	Improvement in corporate governance, cost reduction programs and evaluation of attractive greenfield investments for future growth

13: Iberdrola Renovables SAU (Spain)

Brief description	Develops, constructs, operates and exploits power plants that use renewable energy sources as well as sells electric energy. Research and development of technologies such as marine biomass and tidal energy. Facilities include wind, mini-hydroelectric and thermo-solar energy power stations.
Products sold	Power plant setup and consultancy
Financials (LTM)	Revenue: \$3.0 billion USD, year-over-year change: (1.4%) Operating profit: \$0.9 billion USD, year-over-year change: (3.4%) Net income: \$0.6 billion USD, year-over-year change: (4.9%)
Expected capital expenditure (2010)	\$3.0 billion USD
Geographic coverage (2009)	Spain: 42%; US: 40%; UK: 11%; Rest of the world: 8%
Future plans	Maintain price stability and profit margins under the new regulation scenario along with capacity expansion

14: Light SA (Brazil)

Brief description	Generates, transmits, distributes and commercializes electric energy through five generating power plants and two pumping stations. The generating system is composed of hydraulic structures such as reservoirs, dams, canals, dike, spillways, tunnels, forced ducts and water intakes.
Products sold	Electricity generation, transmission, distribution and commercialization
Financials (LTM)	Revenue: \$3.0 billion USD, year-over-year change: 0.8% Operating profit: \$0.5 billion USD, year-over-year change: (25.9%) Net income: \$0.3 billion USD, year-over-year change: (37.9%)
Expected capital expenditure (2010)	\$2.1 billion USD
Geographic coverage (2009)	Brazil: 100%
Future plans	Expand in distribution and generation

15: VeraSun Energy Corporation (US)

Brief description	Produces and sells ethanol and its co-products through five ethanol production facilities in the US. Ethanol production capacity is 560 million gallons per year, representing 7% of total ethanol production capacity in the US. Completed a merger with US BioEnergy Corp in 2008.
Products sold	Ethanol and its co-products, including wet and dry distiller grains with solubles and corn oil used as an animal feed, as well as to produce biodiesel.
Financials (LTM)	Revenue: \$2.9 billion USD, year-over-year change: 52.1% Operating loss: \$0.1 billion USD, year-over-year change: (64.8%) Net loss: \$0.4 billion USD, year-over-year change: (64.9%)
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	US: 99%; Rest of the world: 1%
Future plans	Restructuring and capacity expansion

16: First Solar, Inc. (US)

Brief description	Manufactures and sells solar modules with an advanced thin film semiconductor technology. Designs, constructs and sells PV solar power systems. Acquired OptiSolar Inc.'s solar power project development business in April 2009.
Products sold	PV solar power systems, PV modules, project development, engineering, procurement and construction services, operating and maintenance services, and project finance
Financials (LTM)	Revenue: \$2.2 billion USD, year-over-year change: 65.8% Operating profit: \$0.7 billion USD, year-over-year change: 55.0% Net income: \$0.7 billion USD, year-over-year change: 83.8%
Expected capital expenditure (2010)	\$0.7 billion USD
Geographic coverage (2009)	Germany: 65%; France: 12%; US: 7%; Rest of the world: 12%
Future plans	Maintain low costs under regulated pricing environment

17: Hafslund ASA (Norway)

Brief description	Generates renewable power and develops bioenergy, distance heating systems and solar energy. Operates under these business units: heat and power, district heating and markets.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$2.0 billion USD, year-over-year change: (3.5%) Operating profit: \$0.2 billion USD, year-over-year change: NM Net income: \$0.1 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.5 billion USD
Geographic coverage (2009)	Norway: 100%
Future plans	Development of renewable energy infrastructure

18: Suntech Power Holdings Company (China)

Brief description	Designs, develops, manufactures and markets PV products, including a range of building-integrated PV products. Also provides engineering, procurement and construction services for building solar power systems using its own solar modules for certain related party and third-party customers. Provides electric power for residential, commercial, industrial and public utility applications.
Products sold	Solar PV items
Financials (LTM)	Revenue: \$1.9 billion USD, year-over-year change: (12.0%) Operating profit: \$0.2 billion USD, year-over-year change: (4.7%) Net income: \$0.1 billion USD, year-over-year change: 164.2%
Expected capital expenditure (2010)	\$0.2 billion USD
Geographic coverage (2009)	Europe (excluding Italy): 62%; Italy: 12%; US: 9%; Japan: 5%; China: 4%; Rest of the world: 7%
Future plans	Maintain gross margin by employing a sound forex hedging strategy

19: Tractebel Energia SA (Brazil)

Brief description	Operates hydroelectric and thermoelectric power plants in the states of Rio Grande do Sul, Santa Catarina, Parana, Mato Grosso, Mato Grosso do Sul and Goias with an installed capacity of 6,431 MW. Principal customers include electricity distributors and traders.
Products sold	Cogeneration, electricity and steam generation, and project installation/commission services
Financials (LTM)	Revenue: \$1.9 billion USD, year-over-year change: 1.6% Operating profit: \$1.0 billion USD, year-over-year change: (4.0%) Net income: \$0.6 billion USD, year-over-year change: 1.7%
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Brazil: 100%
Future plans	Focus on the government auction of hydro plants in 2012

20: REpower Systems AG (Germany)

Brief description	Develops, licenses, manufactures and sells wind energy turbines. Also offers after-sales service for the German wind energy sector. Owns three production plants in Husum, Trampe and Bremerhaven in Germany and two international plants, one in Oliveira de Frades, Portugal, and the other in Baotou, China.
Products sold	Wind turbines with rated outputs ranging between 1.5 and 6.15 MW and rotor diameters ranging from 70 to 126 m
Financials (LTM)	Revenue: \$1.8 billion USD, year-over-year change: 7.8% Operating profit: \$0.1 billion USD, year-over-year change: 26.0% Net income: \$0.08 billion USD, year-over-year change: 11.1%
Expected capital expenditure (2010)	\$0.05 billion USD
Geographic coverage (2009)	Germany: 12%; Rest of the world: 88%
Future plans	Margin expansion in 2010-11

21: Guangdong Electric Power Development Company (China)

Brief description	Invests, develops, manages, generates and sells electric power. Provides technical advice and services related to electric power. In-operation controllable installed capacity was 5.3 million KW. Also supplies heat and provides labor services.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$1.8 billion USD, year-over-year change: 4.8% Operating profit: \$0.3 billion USD, year-over-year change: NM Net income: \$0.2 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	China: 100%
Future plans	Stable expansion

22: Companhia Eletricidade Estado da Bahia - COELBA (Brazil)

Brief description	Produces, transmits, distributes and sells electricity for residential, commercial, industrial and rural consumption along with energy related services such as import, export and technical support.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$1.8 billion USD, year-over-year change: 7.6% Operating profit: \$0.5 billion USD, year-over-year change: (3.1%) Net income: \$0.4 billion USD, year-over-year change: (0.7%)
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Brazil: 100%
Future plans	Maintain margins and augment capacity

23: China Yangtze Power Company (China)

Brief description	Generates and supplies hydroelectric power. Also invests in electric power generation; provides consulting on electricity generation technology; and monitors and maintains hydropower engineering projects. Generated 51.37 billion KW hours of electric power in 2009.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$1.8 billion USD, year-over-year change: 17.5% Operating profit: \$0.1 billion USD, year-over-year change: 14.6% Net income: \$0.6 billion USD, year-over-year change: 15.3%
Expected capital expenditure (2010)	\$3.0 billion USD
Geographic coverage (2009)	China: 100%
Future plans	Create a brand name for the company amid the stringent low carbon emission policy and increase in demand for hydro power

24: Raetia Energie AG (Switzerland)

Brief description	Generate and trade electricity for the national, international and local energy markets with concentration on wind, hydro and thermal (gas- and coal-fired) power plants. Acquired Elcomex En in June 2010 to increase its presence in Romania.
Products sold	Operation of hydroelectric power plants and windmills; electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$1.7 billion USD, year-over-year change: (1.2%) Operating profit: \$0.2 billion USD, year-over-year change: (26.1%) Net income: \$0.01 billion USD, year-over-year change: 10.7%
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Italy: 62%; Switzerland: 33%; Rest of the World: 5%
Future plans	Expansion through aggressive acquisitions

25: EDF Energies Nouvelles SA (France)

Brief description	Generates electricity through renewable energy sources with specialization in electricity from wind power. Owns 67 wind farms across Europe and the US. Also produces electricity from hydro power through its power plants in France and Bulgaria.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: 15.5% Operating profit: \$0.2 billion USD, year-over-year change: 49.3% Net income: \$0.1 billion USD, year-over-year change: 38.7%
Expected capital expenditure (2010)	\$1.2 billion USD
Geographic coverage (2009)	Europe: 63%; Americas: 37%
Future plans	Capacity expansion target of 4.2 GW by 2012

26: Sunpower Corporation (US)

Brief description	Designs, manufactures and markets high-performance solar electric power technologies. Completed the acquisition of Tilt Solar in 2009. Acquired SunRay Renewable Energy in March 2010.
Products sold	Components include solar cells, solar panels and inverters Systems include solar roof systems, commercial solar roof tiles, solar roof integrated systems and ground mounted SunPower tracker systems Services include solar system design, construction management and maintenance, and monitoring services
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: 6.0% Operating profit: \$0.08 billion USD, year-over-year change: (60.0%) Net income: \$0.06 billion USD, year-over-year change: (62.9%)
Expected capital expenditure (2010)	\$0.3 billion USD
Geographic coverage (2009)	Europe: 53%; US: 43%; Rest of the world: 4%
Future plans	Implement a manufacturing strategy to reduce costs and capital outlays

27: Xinjiang Goldwind Science & Technology Company (China)

Brief description	Manufactures and distributes wind turbine generator sets; develops spare parts; provides wind power services; develops and distributes wind farms; develops and transfers wind power technologies. Wind turbine generator sets accounted for 95.33% of total revenue as of December 31, 2009. Distributes its products in domestic and overseas markets.
Products sold	750 KW and 1.5 MW wind turbine sets
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: 66.1% Operating profit: \$0.3 billion USD, year-over-year change: 98.6% Net income: \$0.3 billion USD, year-over-year change: 92.6%
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	China: 99%; Rest of the world: 1%
Future plans	Expand internationally

28: Covanta Holding Corporation (US)

Brief description	Develops, owns and operates infrastructure for the conversion of waste to energy (known as energy-from-waste). Owns other waste disposal and renewable energy production businesses in the Americas, Europe and Asia.
Products sold	Renewable energy products and waste disposal services
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: (6.8%) Operating profit: \$0.2 billion USD, year-over-year change: (19.0%) Net income: \$0.095 billion USD, year-over-year change: (21.2%)
Expected capital expenditure (2010)	\$0.1 billion USD
Geographic coverage (2009)	US: 88%; India: 11%; Rest of the world: 1%
Future plans	Ensure management stability and expand operations

29: Renewable Energy Corporation ASA (Norway)

Brief description	Produces silicon materials for PV applications as well as wafers, solar cells and modules. Owns other direct and indirect subsidiaries and has a 33% stake in Sovello AG.
Products sold	Polysilicon and silane gas for the PV industry, multi- and monocrystalline wafers for the solar cell industry, and solar cells and modules
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: 11.8% Operating loss: \$0.04 billion USD, year-over-year change: (84.8%) Net loss: \$0.4 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.6 billion USD
Geographic coverage (2009)	Germany: 53%; US: 24%; Sweden: 20%; Rest of the world: 4%
Future plans	Focus on a new financing structure and aggressive expansion

30: Nordex AG (Germany)

Brief description	Manufactures and supplies wind energy systems and specializes in wind turbines with high capacity units. Also provides rotor blades up to 45 m in length; develops electrical and control technologies for wind turbines; and offers technical planning services for wind park systems.
Products sold	Wind turbines: Nordex N100/2500 KW, Nordex S70/1500 KW and Nordex S77/1500 KW turbines for onshore use; Nordex N90/2300 KW and Nordex N90/2500 KW; Nordex N80/2500 KW turbines for offshore use
Financials (LTM)	Revenue: \$1.6 billion USD, year-over-year change: 4.1% Operating profit: \$0.071 billion USD, year-over-year change: (20.2%) Net income: \$0.034 billion USD, year-over-year change: (48.9%)
Expected capital expenditure (2010)	\$0.1 billion USD
Geographic coverage (2009)	Europe: 82%; Americas: 11%; Asia: 7%
Future plans	Maintain stability in the challenging legislative environment in the US and expand product portfolio

31: SolarWorld AG (Germany)

Brief description	Operates in the PV sector with wafer production and sale. Manufactures silicon solar wafers from raw and recycled material, produces cells, manufactures silicon-based solar cells for use in solar power modules and manufactures solar modules.
Products sold	Silicon wafers, solar cells, solar modules, solar construction kits, roof-integrated systems, trackers, flat roof assembly systems, mounting systems, display panels and inverters
Financials (LTM)	Revenue: \$1.5 billion USD, year-over-year change: 12.5% Operating profit: \$0.2 billion USD, year-over-year change: (41.9%) Net income: \$0.057 billion USD, year-over-year change: (60.3%)
Expected capital expenditure (2010)	\$0.3 billion USD
Geographic coverage (2009)	Germany: 41%; US: 4%; Rest of the World: 55%
Future plans	Tap the growing demand through aggressive marketing strategies

32: Green Plains Renewable Energy (US)

Brief description	Engaged in ethanol production and its related products, grain warehousing and marketing, sales and related services of agronomy and petroleum products, and marketing and distribution of in-house and third-party ethanol and distillers grains. Acquired a majority interest in Blendstar, LLC in January 2009. Acquired membership interests in two limited liability companies that owned ethanol plants in Central City and Ord, Nebraska, in July 2009.
Products sold	Distillers grains and ethanol
Financials (LTM)	Revenue: \$1.5 billion USD, year-over-year change: NM Operating profit: \$0.069 billion USD, year-over-year change: NM Net income: \$0.045 billion USD, year-over-year change: (15.0%)
Expected capital expenditure (2010)	\$0.050 billion USD
Geographic coverage (2009)	US: 100%
Future plans	Focus on expanding its diversified agriculture business and reducing dependence on core ethanol business

33: Companhia Energetica de Sao Paulo – CESP (Brazil)

Brief description	Generates and commercializes electric energy for industrial and commercial consumption. Operates 6 hydroelectric plants and 57 generating units with an installed capacity of 7,455 MW.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$1.4 billion USD, year-over-year change: 7.0% Operating profit: \$0.5 billion USD, year-over-year change: NM Net income: \$0.4 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	Brazil: 100%
Future plans	Stable outlook and gradual capacity expansion

34: China Longyuan Power Group (China)

Brief description	Designs, develops, constructs, manages and operates wind farms in areas with wind resources. Also sells electricity to local grid companies. Operated 64 wind power companies at the end of 2009.
Products sold	Electricity generation, transmission and distribution; energy trading
Financials (LTM)	Revenue: \$1.4 billion USD, year-over-year change: 13.9% Operating profit: \$0.6 billion USD, year-over-year change: 63.8% Net income: \$0.1 billion USD, year-over-year change: 165.0%
Expected capital expenditure (2010)	\$3.1 billion USD
Geographic coverage (2009)	China: 100%
Future plans	Aggressive capacity expansion and grid management

35: SMA Solar Technology AG (Germany)

Brief description	Develops, produces and sells inverters and monitoring systems for PV applications.
Products sold	System technology for PV applications in grid-tied and off-grid buildings and commercial field and power plants
Financials (LTM)	Revenue: \$1.3 billion USD, year-over-year change: 37.1% Operating profit: \$0.3 billion USD, year-over-year change: 36.7% Net income: \$0.034 billion USD, year-over-year change: 34.8%
Expected capital expenditure (2010)	\$0.2 billion USD
Geographic coverage (2009)	Germany: 63%; European Union: 25%; Rest of the world: 13%
Future plans	Maintain stable margins in a rapidly falling pricing scenario

36: Yingli Green Energy (China)

Brief description	Designs, manufactures and sells PV modules and designs, assembles, sells and installs PV systems. Annual production capacity was 400 MW each for polysilicon ingots and wafers, PV cells, and PV modules. Completed the acquisition of Cyber Power Group in January 2009 through its principal operating subsidiary in China, Fine Silicon Company.
Products sold	PV modules and PV systems with different sizes and power outputs
Financials (LTM)	Revenue: \$1.3 billion USD, year-over-year change: (4.0%) Operating profit: \$0.2 billion USD, year-over-year change: (46.9%) Net loss: \$0.019 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.4 billion USD
Geographic coverage (2009)	Europe: 88%; Japan: 4%; Korea: 4%; China: 2; US: 2%
Future plans	Focus on rooftop project applications under the California Solar Initiative

37: LDK Solar Company (China)

Brief description	Produces multicrystalline wafers and distributes them globally to manufacturers of PV products, including solar cells and solar modules. Also provides wafer processing services to monocrystalline and multicrystalline solar cell and module manufacturers. Sells polysilicon materials, which include ingots and polysilicon scraps. Acquired a 70% controlling interest in Solar Green Technology in July 2009.
Products sold	Multicrystalline solar wafers (180 and 220 microns in thickness)
Financials (LTM)	Revenue: \$1.2 billion USD, year-over-year change: (33.2%) Operating loss: \$0.2 billion USD, year-over-year change: NM Net loss: \$0.2 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.4 billion USD
Geographic coverage (2009)	Asia-Pacific: 58%; Europe: 37%; North America: 4%
Future plans	Focus on operations to capture the strong demand in Europe

38: Q-Cells SE (Germany)

Brief description	Develops, produces and sells mono- and polycrystalline silicon-based solar cells. Also offers a range of thin film modules and is engaged in project management. Also involved in research and development activities.
Products sold	Mono- and polycrystalline, silicon-based solar cells
Financials (LTM)	Revenue: \$1.1 billion USD, year-over-year change: (35.9%) Operating loss: \$0.8 billion USD, year-over-year change: NM Net loss: \$1.4 billion USD, year-over-year change: NM
Expected capital expenditure (2010)	\$0.2 billion USD
Geographic coverage (2009)	Germany: 57%; Rest of Europe: 32%; Asia: 6%; Africa: 3%; North America: 2%
Future plans	Cost reduction program along with liquidity management

39: NHPC Limited (India)

Brief description	Plans, develops and implements an integrated network of hydroelectric projects in India. Also provides contract-based technical, management advisory and consultancy services to domestic and international clients. Has developed and constructed 13 hydroelectric power stations with a total installed capacity of 5,175 MW as of March 31, 2009.
Products sold	Electricity generation, transmission and distribution through hydro plants
Financials (LTM)	Revenue: \$1.1 billion USD, year-over-year change: 49.2% Operating profit: \$0.6 billion USD, year-over-year change: 53.4% Net income: \$0.5 billion USD, year-over-year change: 83.6%
Expected capital expenditure (2010)	\$1.0 billion USD
Geographic coverage (2009)	India: 100%
Future plans	Capacity expansion and growth

40: Trina Solar Limited (China)

Brief description	Produces standard monocrystalline PV modules and sells the products to distributors, wholesalers, power plant developers and operators, and PV system integrators.
Products sold	PV modules: standard monocrystalline PV modules with power output of 165-240 W and multicrystalline PV modules (215-240 W)
Financials (LTM)	Revenue: \$1.0 billion USD, year-over-year change: 1.6% Operating profit: \$0.2 billion USD, year-over-year change: 35.4% Net income: \$0.1 billion USD, year-over-year change: 59.0%
Expected capital expenditure (2010)	\$0.3 billion USD
Geographic coverage (2009)	Europe: 93%; China: 3%; Rest of the world: 4%
Future plans	Maintain its monopoly status and expand rapidly

41: Colbun SA (Chile)

Brief description	Generates electric energy with total installed capacity of more than 2,500 MW. Operates a network of 13 hydroelectric generating plants and 7 thermal power stations. It is a 35.17%-owned affiliate of Minera Valparaiso SA.
Products sold	Generation, transportation, distribution and supply of thermal and hydroelectric power
Financials (LTM)	Revenue: \$1.0 billion USD, year-over-year change: (17.7%) Operating profit: \$0.3 billion USD, year-over-year change: 63.5% Net income: \$0.2 billion USD, year-over-year change: 317.0%
Expected capital expenditure (2010)	\$0.4 billion USD
Geographic coverage (2009)	Chile: 100%
Future plans	Continue expanding and revise its commercial policies

42: IBC Solar AG (Germany)

Brief description	Provides PV systems and offers solar solutions. Its systems are used in PV power stations and in solar farms that feed power into the grid to systems designed for stand-alone power supply. It has operations in Spain, the Netherlands, Malaysia, France, and Greece.
Products sold	Solar modules, inverters, mounting systems, charge regulators, batteries and installation monitoring systems
Financials (LTM)	Revenue: \$900 million USD, year-over-year change: 36.1% Operating profit: \$30 million USD, year-over-year change: 27.1% Net income: \$20 million USD, year-over-year change: 59.1%
Expected capital expenditure (2010)	NA
Geographic coverage (2009)	NA
Future plans	NA

43: Korea District Heating Corporation (South Korea)

Brief description	Provides district heating and cooling services through cogeneration plants and heat generation facilities, and supplies it to certain districts in Korea. Also invests in developing solar lights, solar heat, wind power, bio-energy and other new and renewable energy sources.
Products sold	Heating/cooling equipment
Financials (LTM)	Revenue: \$900 million USD, year-over-year change: 4.9% Operating profit: \$100 million USD, year-over-year change: 282.6% Net income: \$100 million USD, year-over-year change: NM
Expected capital expenditure (2010)	\$400 million USD
Geographic coverage (2009)	South Korea: 100%
Future plans	Focus on starting new plants and expanding

44: AES Tiete SA (Brazil)

Brief description	Produces and commercializes electric energy from 10 hydroelectric power plants with a production capacity of 2,651 MW. Controlled by Brasileira Energia SA.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$900 million USD, year-over-year change: 3.0% Operating profit: \$600 million USD, year-over-year change: 0.4% Net income: \$400 million USD, year-over-year change: 12.7%
Expected capital expenditure (2010)	\$10 million USD
Geographic coverage (2009)	Brazil: 100%
Future plans	Gradual capacity expansion

45: Conergy AG (Germany)

Brief description	Manufactures products for solar power generation and operates in two business segments: PV and EPURON, i.e. project management for solar farms. Its representatives are present in 16 countries with 347 subsidiaries.
Products sold	System components such as solar cells, solar modules, module frames and electronic components and project management services for institutional investors
Financials (LTM)	Revenue: \$900 million USD, year-over-year change: (38.4%) Operating loss: \$22 million USD, year-over-year change: 74.2% Net loss: \$81 million USD, year-over-year change: 73.8%
Expected capital expenditure (2010)	\$20 million USD
Geographic coverage (2009)	Germany: 46%; Rest of Europe: 35%; Rest of the world: 19%
Future plans	Focus on project financing issues and debt management

46: Aboitiz Power Corporation (Philippines)

Brief description	Generates and distributes hydropower. Purchased a 40% interest in Tsuneishi Holdings (Cebu), Inc. in 2008.
Products sold	Electricity generation, transmission and distribution
Financials (LTM)	Revenue: \$800 million USD, year-over-year change: 89.3% Operating profit: \$300 million USD, year-over-year change: 230.2% Net income: \$300 million USD, year-over-year change: 30.6%
Expected capital expenditure (2010)	\$100 million USD
Geographic coverage (2009)	The Philippines: 100%
Future plans	Stable outlook and gradual capacity expansion

47: Hansen Transmissions International NV (Belgium)

Brief description	Designs and manufactures gearboxes, drivetrains and wind turbine gearboxes for the wind energy market through its production facilities at Edegem and Lommel, Belgium.
Products sold	Wind turbine gearboxes, industrial gearboxes and drive trains
Financials (LTM)	Revenue: \$800 million USD, year-over-year change: (12.6%) Operating profit: NA, year-over-year change: NM Net loss: \$12 million USD, year-over-year change: NM
Expected capital expenditure (2010)	\$100 million USD
Geographic coverage (2009)	The Philippines: 100%
Future plans	Improve margins and undertake cost reduction programs

48: Phoenix Solar AG (Germany)

Brief description	Manufactures PV components and systems. Also offers system solutions and support in planning; logistics services; and additional services (such as training to resellers, electrical installation businesses, electrical retailers and wholesalers, heating/sanitary and roofer companies, and solar retailers).
Products sold	PV components and services
Financials (LTM)	Revenue: \$700 million USD, year-over-year change: 17.5% Operating profit: \$34 million USD, year-over-year change: (64.0%) Net loss: \$24 million USD, year-over-year change: (63.9%)
Expected capital expenditure (2010)	\$4 million USD
Geographic coverage (2009)	Germany: 94%; Rest of the world: 6%
Future plans	NA

49: Clipper Windpower Plc (UK)

Brief description	Design, engineers and manufactures wind turbines and sets up wind energy projects, including engineering, construction and plant operation.
Products sold	Wind turbine and project management
Financials (LTM)	Revenue: \$700 million USD, year-over-year change: (0.8%) Operating loss: \$200 million USD, year-over-year change: 31.2% Net loss: \$200 million USD, year-over-year change: 22.9%
Expected capital expenditure (2010)	\$13 million USD
Geographic coverage (2009)	US: 100%
Future plans	Improvement in operations and focus on restructuring programs

50: CropEnergies AG (Germany)

Brief description	Produces bioethanol for the fuel sector and protein feedstuff.
Products sold	Bioethanol (ProtiGrain and CropPower85)
Financials (LTM)	Revenue: \$500 million USD, year-over-year change: 13.9% Operating profit: \$17 million USD, year-over-year change: (34.5%) Net loss: \$6 million USD, year-over-year change: (24.6%)
Expected capital expenditure (2010)	\$18 million USD
Geographic coverage (2009)	Germany: 49%; Rest of the world: 51%
Future plans	Maintain operation stability under an uncertain demand outlook

Thumbnail summaries of alternative energy activities in various regions

1: Europe

Brief description	Largest region in alternative energy investment with a 38% share in 2009
Key countries	Spain, Germany and Italy
Number of listed alternative energy companies	140
Top 5 domestic companies based on revenues	EDP – \$17.6 billion USD Vestas Wind System – \$8.9 billion USD Verbund – \$4.9 billion USD Gamesa Wind – \$4.3 billion USD RushHydro - Russia – \$3.6 billion USD
Current scenario and outlook	<ul style="list-style-type: none"> Europe is the clear leader in the solar sector on the back of Germany which has the maximum installed capacity of 5.3 GW along with a strong manufacturing base. Despite the recession, European wind and solar companies are financing the expansion of their manufacturing capacity and project portfolios.

2: Asia-Pacific, the Middle East and Africa

Brief description	Second largest region in alternative energy investment with a 34% share in 2009 and fastest emerging player in the alternative energy segment
Key countries	China and India
Number of listed alternative energy companies	124
Top 5 domestic companies based on revenues	Doosan Heavy – \$14.2 billion USD Suzlon India – \$4.2 billion USD Suntech Power – \$1.9 billion USD Guangdong Electrical – \$1.8 billion USD China Yangtze Power – \$1.8 billion USD
Current scenario and outlook	<ul style="list-style-type: none"> Asia is growing the fastest as China doubled its wind capacity in 2009 to fulfill its target of generating 30 GW from wind energy by 2020. China also leads in small hydro capacity and is moving aggressively in this direction. On the investment front, strong IPO activity occurred in China in 2009 to finance growth in manufacturing capacity. Alternative energy investment in Africa remains relatively low, but the continent has seen some progress in both government policies and new investment in renewable energy

3: North America

Brief description	Third largest region in alternative energy investment with a 22% share in 2009 and leader in installed capacity
Key countries	The US and Canada
Number of listed alternative energy companies	192
Top 5 domestic companies based on revenues	First Solar – \$2.2 billion USD Sun Power Corp – \$1.7 billion USD Covanta Holding – \$1.6 billion USD Green Plains Renewable – \$1.5 billion USD Canadian Solar – \$0.6 billion USD
Current scenario and outlook	<ul style="list-style-type: none"> North America leads the world in installed wind, biomass and geothermal power capacity but is very close to losing its lead in overall installed capacity as China surges forward. In terms of venture capital investments, this region was the winner in 2009 with its strong foundation of technology innovation.

4: Latin America and the Caribbean

Brief description	Emerging region
Key countries	Brazil and Mexico
Number of listed alternative energy companies	28
Top 5 domestic companies based on revenues	Eletrabras-PR – \$13.5 billion USD CEMIG - Brazil – \$6.6 billion USD Endesa Chili – \$4.2 billion USD Light SA – \$3.1 billion USD Tractebel – \$1.9 billion USD
Current scenario and outlook	<ul style="list-style-type: none"> Brazil accounted for almost all renewable energy investment in 2009 in Latin America, which is poised for significant growth in wind energy investments. Brazil stands out as a G-20 leader and is a top clean energy investment destination. By the end of 2009, ethanol in Brazil accounted for more than 60% of fuel consumption by light vehicles. The Brazilian Development Bank was the year's largest provider of project finance globally to the renewable energy sector.

Thumbnail summaries of alternative energy activities in various countries

1: Brazil	
Brief description	Second among emerging economies in clean energy investments in 2009. Has the world's leading ethanol infrastructure compared to its economy's size
Investment in 2009 / Five-year growth rate	\$7.4 billion USD / 147.8 percent
Key sectors	Ethanol (30 billion liters), biomass (5,100 MW) and small hydro (4,100 MW)
Number of listed companies**	20
Clean energy policies	Renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs and green bonds
Top 3 domestic companies based on revenues	Elektrobras – \$13.5 billion USD Companhia Energética de Minas Gerais (CEMIG) – \$6.6 billion USD Companhia Paranaense Energia (COPEL) – \$3.1 billion USD
Key investment incentives	· Wind: generation based subsidies/ preferential the Brazilian Development Bank (BNDES) loans · Small hydro: generation based subsidies / preferential BNDES loans
2: Canada	
Brief description	Recorded a 40 percent increase in clean energy investment in 2009 and has 7.6 GW of renewable energy capacity
Investment in 2009 / Five-year growth rate	\$3.3 billion USD / 70.2 percent
Key sectors	Wind (3,056 MW) and small hydro (2,000 MW)
Number of listed companies**	61
Clean energy policies	Renewable energy standard, clean energy tax incentives, auto efficiency standards and feed-in tariffs
Top 3 domestic companies based on revenues	Brookfield Renewable – \$1.2 billion USD Canadian Solar – \$0.67 billion USD Northland Power – \$0.2 billion USD
Key investment incentives	· Wind/Solar/Biomass: generation based subsidies / preferential loans (primarily through provincial governments)
3: China	
Brief description	Second worldwide in terms of installed renewable energy capacity (52.5 GW). Targeting 30 GW each from wind and biomass energy by 2010
Investment in 2009 / Five-year growth rate	\$34.6 billion USD / 144.3 percent
Key sectors	Wind (12,200 MW), biomass (2,880 MW) and solar PV (140 MW)
Number of listed companies**	33
Clean energy policies	Renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs and green bonds
Top 3 domestic companies based on revenues	Suntech Power – \$2.1 billion USD Guangdong Electric – \$1.9 billion USD China Yangtze Power – \$1.7 billion USD
Key investment incentives	· Wind: fixed feed-in tariff · Renewable energy: renewable energy surcharge and subsidy scheme · Solar: rooftop and building integrated PV tax subsidies
4: Germany	
Brief description	A global leader in clean energy, with renewable energy accounting for 29 percent of total power capacity. Investment rose more than 17 percent in 2009, and government support is high
Investment in 2009 / Five-year growth rate	\$4.3 billion USD / 75.3 percent
Key sectors	Wind (23,900 MW), solar (7,757 MW) and biomass (3,631 MW)
Number of listed companies**	48
Clean energy policies	Carbon market, renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs and government procurement
Top 3 domestic companies based on revenues	Repower Systems – \$1.8 billion USD Nordex SE – \$1.6 billion USD SolarWorld AG – \$1.5 billion USD
Key investment incentives	· Renewable Energy: favorable credit terms with interest rates fixed in the 4% to 7% range. · Solar PV: commercial installations exempt from VAT

5: India

Brief description	A leading nation in wind power (1.1 GW) and backed by strong provincial feed-in-tariff policies. Intends to generate a massive 20 GW of solar power by 2020
Investment in 2009 / Five-year growth rate	\$2.3 billion USD / 72.0 percent
Key sectors	Wind (10,891 MW), small hydro (2,520 MW) and biomass (2,057 MW)
Number of listed companies**	14
Clean energy policies	Renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs, government procurement and green bonds
Top 3 domestic companies based on revenues	Suzlon Energy – \$4.3 billion USD NHPC Ltd – \$1.1 billion USD JSW Energy Ltd – \$0.5 billion USD
Key investment incentives	· Wind/Solar: feed-in tariffs · Small hydro, biomass: accelerated depreciation of 80% in the first year · Renewable energy projects: preferential tax rate of 15% instead of the standard 30%

6: Italy

Brief description	First country in which solar power has achieved parity with other electric sources. Has 9.8 GW of renewable installed capacity. Under the EU policy, the country has a target to generate at least 25 percent of its electricity from renewable energy.
Investment in 2009 / Five-year growth rate	\$2.6 billion USD / 110.6 percent
Key sectors	Wind (3,700 MW), solar (1,042 MW) and biomass (1,152 MW)
Number of listed companies**	6
Clean energy policies	Carbon market, renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs and government procurement
Top 3 domestic companies based on revenues	Actelios SPA – \$0.13 billion USD Ternienergia SPA – \$0.08 billion USD Erg renew SPA – \$0.08 billion USD
Key investment incentives	· Wind/ Solar/Biomass: feed-in tariffs · Biomass: 30% of capital expenditure for biomass and hybrid units · Residential renewable energy projects: 30-60% refund on the capital cost of projects

7: Mexico

Brief description	Wind accounts for 86 percent of 2009 clean energy investments. Current policy framework does not encourage substantial investment in renewable energy
Investment in 2009 / Five-year growth rate	\$2.1 billion USD / 91.9 percent
Key sectors	Geothermal (965 MW), biomass/biogas (498 MW), and small hydro (377 MW)
Number of listed companies**	-
Clean energy policies	Clean energy tax incentives, auto efficiency standards and feed-in tariffs
Top 3 domestic companies based on revenues	-
Key investment incentives	· Wind/Geothermal/Biomass: generation based subsidies · Renewable energy: 50-70% discount on power transmission through renewable energy plants with capacity of 500 KW

8: Spain

Brief description	Financial crisis and budget difficulties cut 2009 investment by more than 50 percent from 2008. Wind and solar have been the two primary areas of investment.
Investment in 2009 / Five-year growth rate	\$10.4 billion USD / 79.7 percent
Key sectors	Wind (16,740 MW), solar (3,604 MW) and biomass (483 MW)
Number of listed companies**	5
Clean energy policies	Carbon market, renewable energy standard, clean energy tax incentives, feed-in tariffs and government procurement
Top 3 domestic companies based on revenues	Gamesa – \$4.4 billion USD Iberdrola Renewable – \$3.1 billion USD EDP Renovaveis S – \$0.98 billion USD
Key investment incentives	· Wind/ Solar/Biomass: feed-in tariffs · Biomass co-generation: preferential loans of up to 1.5 million EUR · Biofuels: exempt from hydrocarbon tax until 2012

9: United Kingdom

Brief description	Focus is primarily on wind energy, especially offshore wind power. Targeting 20 percent of its electricity and 10 percent of its fuel needs from renewable energy by the end of 2010
Investment in 2009 / Five-year growth rate	\$11.2 billion USD / 127.4 percent
Key sectors	Wind (4,000 MW) and biomass (484 MW)
Number of listed companies**	20
Clean energy policies	Carbon market, renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs, government procurement and green bonds
Top 3 domestic companies based on revenues	Clipper Wind Power – \$0.74 billion USD PV Crystalox Solar PLC – \$0.33 billion USD GTL Resources PLC – \$0.22 billion USD
Key investment incentives	· Renewable energy electricity: renewable energy exempt from £4.3/MWh climate change levy · Renewable energy: renewable energy standard with permit trading

10: United States

Brief description	The investment scenario remains fragile with tight credit and lack of a strong national policy framework, keeping the US at second position in investment. Nevertheless, the 2009 enactment of long-term production tax credits (wind) and investment tax credits (solar) encouraged clean energy investments. The US dominates in venture finance and technology innovation, but it lags in manufacturing.
Investment in 2009 / Five-year growth rate	\$18.6 billion USD / 102.7 percent
Key sectors	Ethanol (47 million liters) and wind (31,900 MW)
Number of listed companies**	131
Clean energy policies	Carbon market, renewable energy standard, clean energy tax incentives, auto efficiency standards, feed-in tariffs, government procurement and green bonds
Top 3 domestic companies based on revenues	FirstSolar Inc – \$2.2 billion USD Sunpower Corp – \$1.7 billion USD Covanta Holding – \$1.6 billion USD
Key investment incentives	· Wind, Solar: production tax credits / investment tax credits · Cleantech: federal loan guarantees · Wind/Solar/Power Storage: federal manufacturers tax credit (policies & incentives provided by local, state and federal governments)

Source: Bloomberg New Energy Finance
** The alternative energy sector is dominated by private companies.

Appendix B: Summary of M&A Deals¹ in the Alternative Energy Sector

The alternative energy sector recorded 391 deals valued at 20.4 billion USD in LTM ending Q2 2010, representing a strong upside of 54.8% in terms of deal value (13.2 billion USD during the previous period with 389 deals). Dollar volume in this period included one major deal (GCL Poly/GCL Solar) which represented 3.8 billion USD or nearly 18.6 percent of total dollar volume. During the previous period, the largest deal was the acquisition of Endesa SA-Assets by Acciona for 3.6 billion USD.

Particulars	LTM ending 2Q 2009	LTM ending 2Q 2010
Total number of deals	389	391
Deals with available transaction value	175	163
Total transaction value	\$13.2 billion USD	\$20.4 billion USD
Largest deal	Acquisition of Endesa SA-Assets by Acciona for \$3.6 billion USD	Acquisition of GCL Solar Energy by GCL Poly for \$3.8 billion USD
Top 5 deals as a % of total deal value	47.2%	34.5%

In terms of business segment, solar and wind accounted for the highest in terms of value at nearly 58% of total dollar volume for the period.

Top Five Segments	No. of transactions	Value (USD bn)
Solar	85	7.2
Wind	150	4.7
Biofuels	53	2.8
Energy efficiency	9	2.1
Cogeneration plants	13	1.6

In terms of geography, China saw the highest transaction value of 5.4 billion USD with a total of 23 deals in the last 12 months, mainly in the solar segment. The US came in second with a value of 2.6 billion USD through 72 deals. Among regions, Asia was the clear leader at 8.9 billion USD.

Top Five Countries	No. of transactions	Value (USD bn)
China	23	5.4
US	72	2.6
Spain	36	2.6
The Philippines	7	1.6
India	14	1.1

Top Five Regions	No. of transactions	Value (USD bn)
Asia	63	8.9
Europe	183	6.8
North America	110	3.6
Middle East	4	0.5
South America	12	0.4

¹ Only mergers and acquisitions have been considered.

Source: Thomson M&A Database

Summary of Transactions¹ in the Alternative Energy Sector in LTM ending 2Q 2010, by Country

Country	# of Transactions in 2009	Total Transaction Value in USD mn	Average EV/Revenue (x)	Average EV/EBITDA (x)	Average EV/EBIT (x)
China	23	5,370.0	-	-	-
United States	72	2,592.2	40.8	-	-
Spain	36	2,527.8	-	-	6.4
Philippines	7	1,560.7	0.8	3.3	4.3
India	14	1,061.2	13.1	39.1	62.7
Canada	37	1,049.1	8.0	14.0	27.1
Hong Kong	6	801.7	3.2	39.5	64.1
Ireland	2	743.1	-	-	-
Switzerland	8	671.3	1.9	7.7	11.3
Norway	5	504.0	2.1	5.9	8.0
Israel	3	430.8	-	-	-
Italy	29	407.5	23.6	-	-
Brazil	7	356.2	-	-	-
France	10	354.5	-	-	-
Australia	17	338.3	5.2	18.3	25.1
United Kingdom	12	327.5	-	-	-
Malta	1	314.5	-	-	-
Finland	3	253.4	-	-	-
Greece	5	217.8	-	-	-
Germany	25	186.0	-	-	-
Poland	4	109.6	-	-	-
Hungary	2	72.5	-	-	-
Iceland	2	39.9	-	-	-
Portugal	4	30.7	-	-	-
Belgium	6	30.0	149.5	-	-
Mozambique	1	4.0	-	-	-
Sweden	7	3.5	-	-	-
Malaysia	2	2.9	-	-	-
Thailand	3	1.9	-	-	-
Sri Lanka	1	1.7	-	-	-
Estonia	1	1.2	-	-	-
Czech Republic	6	1.2	-	-	-
Bulgaria	2	0.4	-	-	-
Turkey	3	0.2	-	-	-
Netherlands	6	-	-	-	-
Denmark	3	-	-	-	-
Argentina	2	-	-	-	-
Ecuador	2	-	-	-	-
Vietnam	2	-	-	-	-
Austria	1	-	-	-	-
Azerbaijan	1	-	-	-	-
Bahrain	1	-	-	-	-
Chile	1	-	-	-	-
Indonesia	1	-	-	-	-
Laos	1	-	-	-	-
Nicaragua	1	-	-	-	-
Romania	1	-	-	-	-
Russia	1	-	-	-	-
South Africa	1	-	-	-	-
Total	391	20,367.6	16.3	20.1	30.4

¹ Only mergers and acquisitions have been considered.

Source: Thomson M&A Database

Summary of Transactions¹ in the Alternative Energy Sector in LTM ending 2Q 2010, by Type of Source

Segments	# of Transactions in 2009	Total Transaction Value in USD mn
Solar	85	7,242.8
Wind	150	4,671.5
Biofuels	53	2,825.0
Energy Efficiency	9	2,106.4
Cogeneration plant	13	1,563.8
Hydro Power	35	740.3
Thermal Power	6	480.3
Other	20	472.7
Geothermal	19	234.7
Ocean	1	30.0
Total	391	20,367.6

Summary of Transactions¹ in the Alternative Energy Sector in LTM ending 2Q 2010, by Region

Segments	# of Transactions in 2009	Total Transaction Value in USD mn
Asia	63	8,800.4
Europe	183	6,796.4
North America	110	3,641.3
Middle East	4	430.8
South America	12	356.2
Oceania	17	338.3
Africa	2	4.0
Total	391	20,367.6

Top 15 transactions in the Alternative Energy Sector in LTM

1: GCL Poly Energy/GCL Solar Energy

Announced/Initial Filing Date:	07/31/2009	COMMENTS:
Target/Issuer:	GCL Solar Energy Tech Holding Inc	GCL Poly Energy is a holding entity, which along with its subsidiaries, manufactures polysilicon and wafers for the solar industry and operates clean power plants. Backed by the strong boost from the Chinese government, the company is expanding its manufacturing capacity through aggressive acquisitions.
Total Transaction Value (\$mm USD)	3787.5	
Buyers/Investors:	GCL-Poly Energy Holdings Ltd	Furthermore, China plans to increase its solar generation capacity to 10 GW by 2020 to reduce dependence on coal.
Percent Sought (%):	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	China	
Primary Industry:	Solar	

2: GCL Poly Energy/Greatest Joy International

Announced/Initial Filing Date:	07/31/2009	COMMENTS:
Target/Issuer:	Greatest Joy International Ltd	GCL Poly Energy is a holding entity, which along with its subsidiaries, manufactures polysilicon and wafers for the solar industry and operates clean power plants. Backed by the strong boost from the Chinese government, the company is expanding its manufacturing capacity through aggressive acquisitions.
Total Transaction Value (\$mm USD)	911.6	
Buyers/Investors:	GCL-Poly Energy Holdings Ltd	Furthermore, China plans to increase its solar generation capacity to 10 GW by 2020 to reduce dependence on coal.
Percent Sought (%):	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	China	
Primary Industry:	Solar	

3: Engyco Plc/Not Available

Announced/Initial Filing Date:	03/23/2010	COMMENTS:
Target/Issuer:	Undisclosed solar assets	Engyco Plc, a startup company, is the first listed solar power utility in Europe. It plans to offer a high dividend yield stock with significant growth prospects to its investors by rapidly building a large-scale independent electricity producing utility.
Total Transaction Value (\$mm USD)	863.8	
Buyers/Investors:	Engyco PLC	Hence, the company has bought operational solar power assets in Spain.
Percent Sought (%):	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	Spain	
Primary Industry:	Energy Efficiency	

4: Bord Gais Eireann/SWS Natural Resources

Announced/Initial Filing Date:	12/04/2009	COMMENTS:
Target/Issuer:	SWS Natural Resources Ltd	The acquirer intends to follow a dual-fuel operational strategy.
Total Transaction Value (\$mm USD)	743.1	
Buyers/Investors:	Bord Gais Eireann	The acquisition will strengthen its asset base and make available renewable energy resources for it to provide a sustainable and competitive electricity offering.
Percent Sought (%):	100.0	Additionally, SWS Natural Resources a large wind generator and has seen success in the development and operation of wind assets in Ireland.
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	Ireland	
Primary Industry:	Wind	

5: China Investment Corp/GCL Poly Energy

Announced/Initial Filing Date:	11/19/2009	COMMENTS:
Target/Issuer:	GCL-Poly Energy Holdings Ltd	CIC, a sovereign wealth fund, invests in energy and commodities companies to hedge against inflation.
Total Transaction Value (\$mm USD)	717.9	CIC and GCL-Poly intend to establish a joint venture to invest in and develop PV projects or other solar energy projects.
Buyers/Investors:	China Investment Corp (CIC)	
Percent Sought (%):	-	
Implied Enterprise Value/Revenues:	6.7	
Implied Enterprise Value/EBITDA:	49.4	
Implied Enterprise Value/EBIT:	97.6	
Headquarters-Country:	Hong Kong	
Primary Industry:	Wind	

6: TransAlta/Canadian Hydro Developers

Announced/Initial Filing Date:	11/03/2009	COMMENTS:
Target/Issuer:	Canadian Hydro Developers Inc	With this merger, the combined entity is expected to have operational and development expertise, a robust growth portfolio, a strong balance sheet and will be well positioned as a North American leader in renewable energy.
Total Transaction Value (\$mm USD)	698.09	
Buyers/Investors:	TransAlta	
Percent Sought (%):	96.8	
Implied Enterprise Value/Revenues:	8.3	The new entity will have a net generation capacity of 8,657 MW in operation in which the renewable portfolio will include 1,900 MW in operation or 22 percent of the combined portfolio.
Implied Enterprise Value/EBITDA:	14.2	
Implied Enterprise Value/EBIT:	29.4	
Headquarters-Country:	Canada	
Primary Industry:	Biofuels	

7: Therma Luzon/NAPOCOR-Pagbilao

Announced/Initial Filing Date:	08/29/2009	COMMENTS:
Target/Issuer:	NAPOCOR-Pagbilao Power Plant	Aboitiz Power Corporation's subsidiary Therma Luzon is expected to expand its capacity portfolio through acquisitions.
Total Transaction Value (\$mm USD)	691.0	
Buyers/Investors:	Therma Luzon Inc	With the acquisition of Pagbilao, its attributable capacity is expected to increase by 87% to 1,940 MW.
Percent Sought (%):	-	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	The Philippines	
Primary Industry:	Cogeneration Plant	

8: China Investment Cor/AES Corp

Announced/Initial Filing Date:	11/06/2009	COMMENTS:
Target/Issuer:	AES Corp-Wind Generation Bus	CIC, an investment institution, had invested in AES which is a Fortune 500 global power company with generation and distribution businesses. This stake sale will allow AES to take advantage of investment projects by CIC and enable AES to pursue M&A transactions for expansion.
Total Transaction Value (\$mm USD)	571.0	
Buyers/Investors:	CIC	
Percent Sought (%):	15.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	Additionally, CIC would help in expanding AES' footprint in Asia, where the largest growth in electricity demand is estimated.
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	US	
Primary Industry:	Solar	

9: Jaiprakash Hydro/Jaiprakash Power

Announced/Initial Filing Date:	12/14/2009	COMMENTS: With this deal, JP Hydro and JP Power would have a presence in the power sector to the extent of 13,000 MW. This includes a thermal hydro mix, where thermal power would be 8,000 MW and hydro would be 5,000 MW.
Target/Issuer:	Jaiprakash Power Ventures Ltd	
Total Transaction Value (\$mm USD)	556.6	
Buyers/Investors:	Jaiprakash Hydro-Power Ltd	
Percent Sought (%)	100.0	
Implied Enterprise Value/Revenues:	9.2	
Implied Enterprise Value/EBITDA:	10.1	
Implied Enterprise Value/EBIT:	12.2	
Headquarters-Country:	India	
Primary Industry:	Energy Efficiency	

10: Strategic Power Development Corporation/San Roque Power

Announced/Initial Filing Date:	12/17/2009	COMMENTS: Strategic Power is primarily involved in producing and generating electricity as well as supplying and consolidating the electric power demand of end users. This hydro power plant acquisition will boost Strategic Power's capacity by about 345 MW.
Target/Issuer:	San Roque Power Corp-	
Total Transaction Value (\$mm USD)	450.0	
Buyers/Investors:	Strategic Power Development Corp	
Percent Sought (%)	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	The Philippines	
Primary Industry:	Hydro Power	

11: Iberdrola Renovables/El Andevalo Wind Farm

Announced/Initial Filing Date:	02/10/2010	COMMENTS: The acquisition of El Andevalo Wind Farm Complex, the largest renewable energy facility in Spain, makes Iberdrola the largest wind energy development company in Spain. This acquisition will add 5,520 MW to the acquirer's installed capacity base in Spain. Moreover, this merger is strategic in that the electricity interconnection between Spain and Portugal will improve.
Target/Issuer:	El Andevalo Wind Farm Complex	
Total Transaction Value (\$mm USD)	439.6	
Buyers/Investors:	Iberdrola Renovables SA	
Percent Sought (%)	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	Spain	
Primary Industry:	Wind	

12: Siemens AG/Solel Solar

Announced/Initial Filing Date:	10/19/2009	COMMENTS: With this acquisition, Siemens will be able to offer the key components for the construction of parabolic trough power plants from a single source. The acquisition will also help in further enhancing the efficiency of these plants as Siemens is the market leader in steam turbines for solar thermal power plants and Solel has a high-efficiency receiver technology and comprehensive expertise in the engineering and construction of solar fields.
Target/Issuer:	Solel Solar Systems Ltd	
Total Transaction Value (\$mm USD)	418.0	
Buyers/Investors:	Siemens AG	
Percent Sought (%)	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	Israel	
Primary Industry:	Solar	

13: Investor Group/Renewable Energy Corp ASA

Announced/Initial Filing Date:	08/12/2009	COMMENTS: An investor group comprised of Hafslund Venture AS, a majority-owned unit of Norwegian state-owned Hafslund ASA, and Orkla ASA planned to acquire a minority stake in Renewable Energy Corp ASA.
Target/Issuer:	Renewable Energy Corp ASA	
Total Transaction Value (\$mm USD)	380.6	
Buyers/Investors:	Investor Group	
Percent Sought (%)	Minority Stake	
Implied Enterprise Value/Revenues:	2.1	
Implied Enterprise Value/EBITDA:	5.9	
Implied Enterprise Value/EBIT:	7.9	
Headquarters-Country:	Norway	
Primary Industry:	Solar	

14:NextEra Energy Resources/ Babcock & Brown

Announced/Initial Filing Date:	10/01/2009	COMMENTS: This acquisition strengthens NextEra Energy's clean energy leadership in North America and is consistent with its strategy to profitably grow its wind portfolio. As all these projects are located in markets with very strong wind regimes and utilize proven wind turbine technology, it will improve the wind portfolio for NextEra. All three wind farms have a combined capacity of 184.5 MW.
Target/Issuer:	Babcock & Brown-Wind Proj(3)	
Total Transaction Value (\$mm USD)	352.0	
Buyers/Investors:	NextEra Energy Resources LLC	
Percent Sought (%):	-	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	United States	
Primary Industry:	Wind	

15: OneTaipan Holdings/ Monte Oro Grid Resources

Announced/Initial Filing Date:	03/17/2010	COMMENTS: OneTaipan Holding's strategy is to make investments in the power sector, which is critical to the Philippines development and growth. Monte Oro Grid, a company under the Ricky Razon group, was its first investment.
Target/Issuer:	Monte Oro Grid Resources Corp	
Total Transaction Value (\$mm USD)	350.0	
Buyers/Investors:	OneTaipan Holdings	
Percent Sought (%):	100.0	
Implied Enterprise Value/Revenues:	-	
Implied Enterprise Value/EBITDA:	-	
Implied Enterprise Value/EBIT:	-	
Headquarters-Country:	The Philippines	
Primary Industry:	Cogeneration Plant	

Appendix C: Growth Drivers of Alternative Energy sector

Investment Trends

- The remarkable progress in the renewable energy industry over the recent years is resulting in an increase in the number and size of corporate and institutional investments in the sector. The growing scale of renewable energy investments has been evident at every stage in the asset life cycle, from project planning and construction to commercialization.
- Growth in the global renewable energy sector has been continually breaking its own record year after year since 2004 except in the year 2009 when the sector faced the impact of the financial crisis. However, the long-term growth fundamentals of the sector remained intact. New clean energy investment amounted to 145 billion USD in 2009, down by just 6.5 percent, from 155 billion USD in 2008. Asia has emerged as a big consumer of energy; it was also one of the largest investors in clean energy capacity in 2009. Investments were particularly high in China, including the 2.6 billion USD IPO of China Longyuan Power, and spending on large-scale solar and wind projects have been massive.
- On the venture capital (VC) and private equity (PE) front, 2009 witnessed a sharp decline from the previous year. A total of 6.6 billion USD was invested in 2009, down significantly by 44 percent compared to 2008. It was a difficult year for investors, and it was even more difficult for young companies looking for venture funding and, in particular, expansion capital.
- In conclusion, small-scale project developers and independent power purchasers are finding it difficult to finance their projects and are selling out to more established players. Money is only being lent to companies with strong balance sheets and those having a close relationship with banks. As bigger deals generally have the security of larger, more creditworthy developers, they are naturally more likely to reach completion under difficult circumstances than smaller deals with less well-established counterparties.

Growth Drivers

To address the global challenges of energy security, climate change and sustainable development, the development of advanced clean energy technologies is imperative. Following are the main growth drivers.

Declaration of stimulus package for renewable projects in 2009—a major boost

- Renewable energy is most typically attractive in a policy-driven market. This is because it is often only marginally competitive, if at all, compared with conventional power on a stand-alone basis as economies of scale have yet to be realized and existing market structures may contain inbuilt systems or subsidies that favor conventional energy. Hence, fiscal support is imperative for the projects to be attractive to equity investors and lenders as they will be comparing the renewable energy investment against alternative uses of that capital that may provide higher returns, including conventional forms of energy.
- The renewable energy sector is currently benefiting from policy interventions aimed at incentivizing the use of various renewable technologies through stimulus packages declared in 2009 by various governments. These incentives are provided through feed-in tariffs (more popular in Europe), renewable energy obligation on suppliers (with an associated certificate trading), portfolio standards or tax-based incentives, i.e., production tax credits (more popular in the US).
- In 2009, globally, 184.4 billion USD worth of stimulus packages were declared which will be spent over a period of five years till 2013. The years 2010 and 2011 will see maximum spending—nearly 65 percent of the total package.
- In terms of geography, the US leads in stimulus packages at 66.6 billion USD which is 36 percent of the total packages announced.

The US is followed by China at 46.9 billion USD and South Korea at 27.8 billion USD. It is expected that more than one-third of the stimulus amount will be spent on creating solutions for improving energy efficiency.

Grid parity—catalyst for alternative energy uptake

- Achieving grid parity has been the biggest challenge for alternative energy. It has always been considered that technologies like wind and solar cannot compete with conventional sources such as coal and nuclear in terms of pricing. In fact, the consensus view is that alternative energy would not have a presence if it were not for direct subsidies or large government tax breaks. However, alternative energy has lately seen huge advances in terms of technology and is slowly realizing economies of scale. Wind power looks to be the first alternative energy source that can attain grid parity. Moreover, with breakthrough advances in solar power happening on a regular basis, the likelihood of solar power achieving grid parity has become even greater.

Commercialization of energy storage technologies benefiting alternative energy

- Energy storage equipment are media that can store any form of energy to be utilized at a later time. Such equipment help in keeping volatility in check, making markets more efficient and improving safeguards. Various energy storage technologies include pumped-hydro storage, compressed air energy storage, regenerative fuel cells, batteries, super-conducting magnetic energy storage, flywheels, thermal and hydrogen.
- Energy storage technologies such as lithium-ion batteries are quietly progressing toward commercialization as they can bundle a high density of energy with a high level of reusability. On the alternative energy storage front, research on grids based on lithium ion technology is progressing rapidly. Electric vehicles and grid storage represent huge potential markets for new energy storage technologies.
- While many of the announcements represent only small steps, they show that a number of technologies are making reasonable progress. The GE backed company, A123 Systems, installed a 2 MW lithium ion storage unit at a California power plant. Valence Technology signed a deal to supply its lithium ion battery systems for a new line of hybrid-electric yachts, sailboats and motorboats from Beneteau Group. GS Battery teamed up with screen-printed solar-cell manufacturer Suniva to develop solar power systems with batteries that can store energy for use in peak demand periods.¹
- Although R&D in the industry is making rapid strides, the technology is still expensive—10 times costlier than lead acid batteries with equivalent capacity. Nevertheless, the stimulus packages have played a big role in raising interest in energy storage technology, setting aside 2 billion USD in advanced battery manufacturing grants and up to 25 billion USD in loans for advanced vehicles, including related energy storage technologies. Furthermore, while these activities in both electric vehicle and clean energy markets have been spurred by government initiatives, private capital is following public capital. Venture capital investment in energy storage grew 23 percent globally in 2009 to 472 million USD.²
- Going forward, more energy storage technologies are likely to hit the market in the next 12 to 18 months as several companies are now completing their evaluation period. Technological improvements and an increase in manufacturing scale in the near future are expected to bring down costs.

¹ <http://www.renewableenergyworld.com/rea/news/article/2010/03/energy-storages-quiet-revolution>

² Cleantech Group

Smart grid: taking grid energy storage to the edge¹ and an enabler of alternative energy transmission

- Grid energy storage refers to large-scale storage of electricity within an electrical power grid; it is useful when energy production and consumption varies randomly over time.

Fundamental Change	From	To
Infrastructure	Centralized energy system	Distributed energy and data
Energy Supply	Commodity service, Focus on unit price	Energy and demand management opportunities
Pricing	Long-term contracts and single price	Dynamic pricing and demand incentives
Regulation	Close ownership/control, Limited competition	Distributed asset ownership, Open competition
Business Models	Traditional utilities	Virtual power plants with customer relationships, Outsourcing opportunities

Source: *New Energy Finance*

- Smart grid is a two-way grid and network technology between supplier and consumer, which helps optimize consumption and increase transparency. The adoption of smart grid will enhance every facet of the electric delivery system, including generation, transmission, distribution and consumption. It will energize those utility initiatives that encourage consumers to modify patterns of electricity usage, including the timing and level of electricity demand. It also involves “Distributed Generation” which is the use of small-scale power generation technologies located close to the load being served; this is capable of lowering costs, improving reliability, reducing emissions and expanding energy options.

Smart energy – the new edge energy – an overview

Smart metering - the foundation for smart grid:

- Grid monitoring and control processes to improve reliability, power quality and security
- Enhanced tariff capabilities enabling consumers to make choices, and lower consumption
- Reduced operational costs associated with meter reading and maintenance

Smart grid - enables distributed generation:

- Asset optimization with two-way communications and advanced applications management
- Energy efficiency and CO2 reduction with decrease in line loss
- Improved reliability with enhanced situational awareness and outage management services

Smart home - gives customers the ability to monitor and control energy usage:

- Customer controlled appliance and energy management
- Flexible, efficient and cost effective utility demand response programs
- Distributed and alternative generation management and dispatching programs

- New business model evolving:** With the implementation of smart grid technology, the electricity industry is poised to make the transformation from a centralized, producer-controlled network to one that is less centralized and more consumer-interactive. The new business model will evolve through the development of new business infrastructure. The move to a smarter grid would change the industry’s entire business model and its relationship with all stakeholders, involving utilities, regulators, energy service providers, technology vendors and consumers.

Smart grid and integration of renewable energy sources:

Alternative energy sources are by nature unpredictable—the amount of electrical energy they produce varies over time and depends significantly on random factors such as the weather. Hence, given the significant concerns regarding climate change, the need for distributed solar and wind power is critical. Integrating wind or solar power into the grid at scale—at levels higher than 20 percent² — will require advanced energy management techniques and approaches at the grid operator level. This is needed to increase efficiency and lower the cost of energy production and/or to facilitate the use of alternative energy sources. In a nut shell, smart grid’s ability to dynamically manage all sources of power on the grid means that more distributed generation can be integrated within it.

Many regions making initiatives for smart grid implementation:

The European Union has an aggressive smart grid agenda which can be seen from the dozens of projects in the pilot phase; it has a target of 80 percent smart metering penetration by 2020.

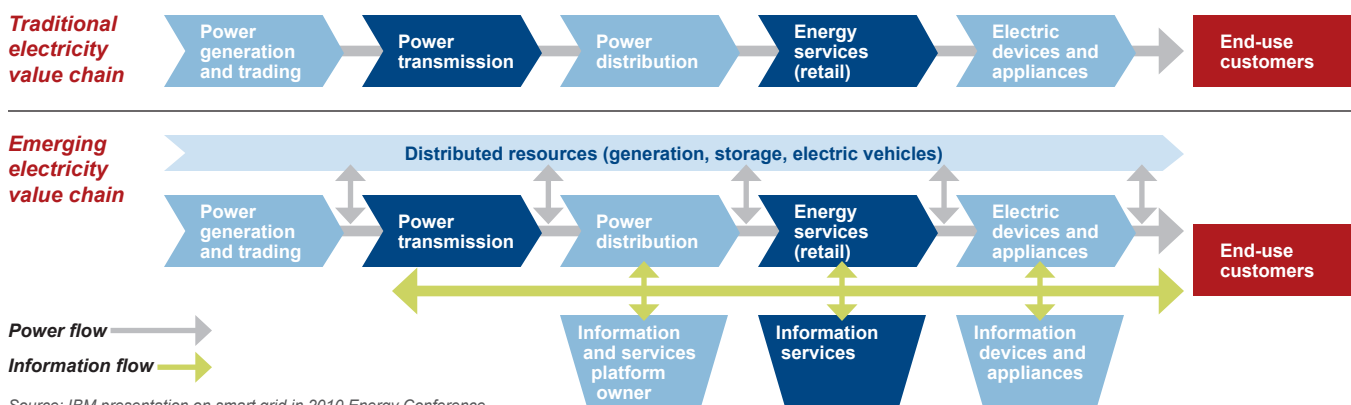
In Asia, Japan is at the forefront of distribution automation through its use of advanced battery storage technology. Singapore is expected to initiate pilot projects on smart metering in 2011. South Korea aims to have a nationwide smart grid by 2030, and Australia has started the Smart City Initiative.

US president Obama is considering smart grid to be crucial in his economic stimulus program; projects worth 1.6 billion USD were initiated in 2009 which includes digital meters in homes, distribution circuits and energy storage devices such as flywheels and batteries.

¹ <http://www.renewableenergyworld.com/real/news/article/2010/05/taking-grid-energy-storage-to-the-edge>

² *The European Wind Energy Association*

The emerging business model



Source: IBM presentation on smart grid in 2010 Energy Conference

Appendix D: Niche Focus Areas

Digital energy – the next-generation phase

- Digital energy is the conjunction of traditional energy, telecom and IT. Control is switching from analog to digital, and data is becoming pervasive throughout the system which goes beyond the current network optimization of grids. There will be new types of data to manage— data on carbon footprints, liberalized pricing, resources and usage patterns. In addition, the cost of sensors and communications is likely to drop dramatically over the years. Thus, in the next 10-20 years, global energy infrastructure is expected to undergo a major transformation.
- While the prospects of digital energy are bright, the industry, regulators and policy-makers are not yet ready to grapple with the implications of moving to a new era. That said, the following players are making active efforts to take advantage of digital energy. Start-ups such as national grid, eMeter, Power Plus Communications, IHD Target, Comverge, Blueline, Energy Aware and Computime are developing tools to gain an early edge. Even IT majors such as SAP, IBM and industrial conglomerate GE are venturing in this area through various small players.

Next step in evolution of energy storage is hydrogen

- Hydrogen is not a primary energy source but is an energy carrier (similar to electricity) and can store and deliver energy in a widely usable form. It is one of the most promising alternative fuels for future transport applications. It is expected that hydrogen will be the key to sustainable energy storage going forward, particularly in regions where grid transmission is unreliable for alternative energy. It is even expected that hydrogen will provide better energy storage solutions with greater versatility and economic benefit than compressed air storage and pumped hydro systems. However, significant development is needed before hydrogen can be exploited in the same way as conventional fossil fuels. An easy way of producing hydrogen is through simple electrolysis, but technical and cost hurdles have made electrolysis impractical.
- However, several players are making a foray in this field. Hydrogenics, a developer and provider of hydrogen generation and fuel cell products and services, and Rosetti Marino, a provider of solutions to oil and gas players, have jointly established a hydrogen power plant. The plants will incorporate Hydrogenics' electrolyzer and fuel cell systems for turnkey applications that produce hydrogen for energy storage and electricity generation.
- These systems will help in expanding the market for renewable energy and act as a catalyst for the transformation and optimization of next generation electrical infrastructure. Another initiative that will give a boost to increasing the market is the FCH Joint Technology Initiative, a private-public partnership between the EU and industries and research institutes in Europe. This initiative will help accelerate the development and deployment of fuel cells and hydrogen (FCH) technologies. The program includes research and technological development, enabling the commercialization of FCH technologies in several application areas. Hydrogen generation, storage and delivery in the US and European markets is estimated at 2 billion USD¹ and is expected to grow at an average annual rate of 15 percent in the next two to three years.

CO2 capture and storage (CCS) is gaining a foothold

- CCS is defined as a system of technologies which involves three stages: CO2 capture, transport and geologic storage. CCS is the most promising solution, especially, for countries reliant on large fossil fuel reserves.
- CO2 emissions from the energy sector are likely to increase by 130 percent from 2005 levels by 2050² in the absence of new

policies or initiatives. CCS is the only technology available to mitigate greenhouse gas emissions from large-scale fossil fuel usage in fuel transformation, industry and power generation. Thus, CCS has strong potential. Startups include A2BE Carbon Capture, Acclergy, Raytheon, Accelergy, Carbon Sciences and Carbon8 Systems.

- However, for the CCS technology to be viable, the associated costs need to be lowered and the technology needs to be demonstrated on a commercial scale. Additional R&D is also needed, particularly to address different CO2 streams from industrial sources and to test biomass and hydrogen production with CCS. Moreover, few regions have made progress in developing dedicated legal and regulatory frameworks for CCS.
- At present, there are five fully integrated, commercial-scale CCS projects in operation which are not large scale. Over the next 10 years, it is expected that 100 CCS projects will be deployed globally³, driven by emerging emission reduction policy frameworks and financial incentives. This would represent a commercial potential of 50 billion USD in 2020⁴.

New breed of bio fuels being developed to prevent energy imbalance

- Global production of first generation biofuels, produced from food crops and vegetable oils, has been increasing rapidly; however, the expanding biofuel industry has recently raised important concerns such as effects on the environment, displacement of food crops, deforestation and climate change. Further, higher biofuel demand in the US and the EU has led to a more than twofold increase in prices of corn and soybean along with livestock feed in the last two years.
- Hence, next-generation biofuels, produced from algae and non-food plants such as jatropha, camelina, witchgrass, woodchips and miscanthus are emerging as a potentially viable alternative to conventional biofuels. These biofuels are not commercialized currently and extensive R&D activities on second-generation biofuels are underway, which is estimated to take at least a decade to become fully operational. The R&D activities are carried out in few developed countries and in some large emerging economies such as Brazil, China and India. In terms of potential, Brazil is the only country to sustainably produce energy crops for second-generation biofuel production, mainly on underutilized pasture land.
- Going forward, it is expected that second-generation biofuels will account for roughly 90 percent of all biofuel production by 2050⁵ with China and India accounting for 19 percent of total production.

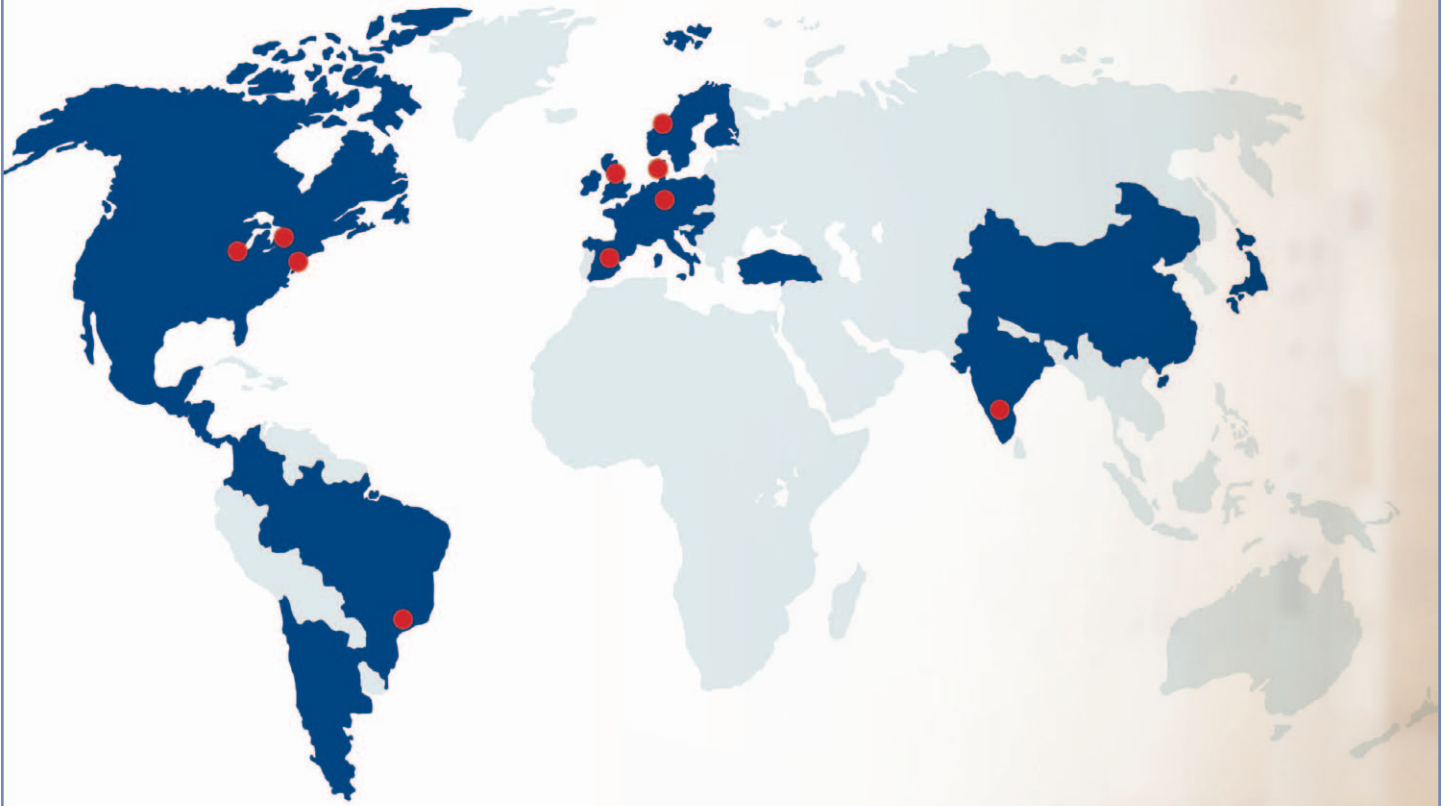
Nanotechnology

- Nanotechnology is a field of applied science involved in the control of matter on an atomic and molecular scale. This technology provides significant potential to enhance energy efficiency in the area of alternative energy through optimized production technologies. It is expected that nanotechnological innovations will be applied in the entire value chain of the energy sector starting from generation to distribution and usage. Nanotechnology is likely to be commercialized the medium to long term.
- Although nanotechnology applications have significant importance, applications in the energy sector are still in the nascent stage, with market spending of around 5 billion USD in 2009 which includes R&D and such other program. Nonetheless, spending is expected to improve at 8.5 percent CAGR from 2009 to 2013⁶.

¹ www.futureenergies.com
² *Energy Technology Perspectives 2008 (ETP)*

³ IEA
⁴ *Estimate by Climate Change Business Journal*
⁵ *Estimate by Energy Technology Perspectives 2008*
⁶ BCC Research

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