AIG Investments℠

RENEWABLE ENERGY: PROFILING THE FOUR TOP SECTORS

Chantal Brennan, *Managing Director, Global Equities*
Patricia Tomás García, *Investment Analyst, Equities*

EXECUTIVE SUMMARY

As a key factor in shaping the global economic landscape, Renewable Energy is poised to play a crucial role. Key drivers include concerns regarding global climate change and the search for alternatives to fossil fuels. Additionally, emerging markets that are becoming steadily more developed with corresponding populations are growing and consuming energy at a rapid pace.

In brief, Renewable Energy relates to any alternative sources of energy obtained from clean, abundant and sustainable resources. The four top sectors in this booming industry are Hydro Power, which focuses on electricity generated from water pressure; Wind Power, which derives from wind speed; Biofuels, which are fuel sources created from easily reproduced organic material; and Solar Power, which derives from sunlight.

Although the degree of technological advancement varies among these forms of Renewable Energy, the final purpose is the same: To generate clean energy from low-cost resources in order to reduce CO_2 emissions and limit energy costs.

- Hydro Power is the oldest form of electrical generation, and, in most parts of the world, represents the lowest cost of generation. In the developed world, most potential sites for Hydro Power have already been utilized; any gains in worldwide Hydro capacity will be made in less developed countries, where it is most needed.
- Wind Power can be cost-competitive with conventional thermal-generated electricity. Although modern Wind Power has been used in various parts of the world for more than 20 years, adoption has only recently become more widespread. Together, these two resources account for the largest share of Renewable Energy worldwide.
- Solar Power, however, is still in the early stages of penetrating markets, due to significant production costs that need to be reduced in order to make it more affordable.
- Although clearly an important component of Renewable Energy, Biofuels are characterized by different investment dynamics, as they are currently used primarily for transportation, and are therefore highly dependent on oil prices.

The following table compares the cost of each type of Renewable Energy in Euros, Dollars and Yen:

TECHNOLOGY	COST PER KWH (€)	COST PER KWH ($)	COST PER KWH (¥)
Conventional electricity	0.03-0.04	0.04-0.05	4.50-6.00
Hydroelectric plant	0.02-0.06	0.03-0.08	3.00-9.00
Biomass	0.04-0.10	0.05-0.14	6.00-15.00
Onshore wind	0.03-0.04	0.04-0.05	4.50-6.00
Offshore wind	0.04-0.07	0.05-0.10	6.00-10.50
Geothermal	0.01-0.07	0.02-0.10	1.50-10.50
Solar thermal	0.09-0.13	0.13-0.20	13.50-19.50
Solar cells	0.18-0.30	0.25-0.42	27.00-45.00

Source: European Wind Energy Association, 2007

Despite increasing popularity, several challenges affect the prospects for Renewable Energy:

- Although abundant, Wind Power is not always available in every environment or climate.
- Due to competition from Biofuels, inflation of animal feedstock prices is severely impacting the food industry.
- Shortages of components for energy-generating equipment are currently affecting the Solar and Wind Power sectors.
- Transmission constraints in the existing grid will limit the deployment of Solar and Wind Power assets. Historically, these resources are located far away from electric load centers.
- Regulatory risks are significant, especially for Solar Power and Biofuels.
- Many energy projects tend to face an increasingly negative bias from the surrounding community.

Most categories of Renewable Energy share similar advantages:

- Generally, these sectors have demonstrated double-digit growth rates for the last 10 years. Future prospects are bright, and these growth rates are expected to continue.
- Renewable Energy represents “clean energy,” because – with one exception – none of these categories produces CO_2 emissions. However, Biofuels reduce polluting gasses, rather than eliminating them entirely.
- Renewable Energy can reduce dependence on hydrocarbons (oil & gas) and limit the production of greenhouse gasses.

- Mandatory targets have been set by political and regulatory bodies regarding the use of Renewable Energy. The EU's Renewable Directive requires a 20% share of energy consumption be channeled into these sectors by 2020.
- Clearly, government support is essential for the development of Renewable Energy. Several initiatives have been implemented to further support investments in these sectors. At the moment, the most widespread include Feed-in Tariffs, Quota Systems, Tax Incentives, and Grants for Renewable Energy research:
  - **Feed-in Tariffs:** Minimum fixed prices are set by the government and guaranteed for a specific period; normally 20 years. These tariffs are primarily used for Solar and Wind Power. This incentive is already in place in European and Scandinavian countries, including Germany, Spain and Denmark.
  - **Quota Systems:** Renewable energy companies sell electricity at market prices, but the government sets a mandatory quota (Green Certificates) that suppliers must fulfill. At present, this is typically encouraging use of Wind and Solar Power. Italy, UK, Belgium and Poland have all introduced similar systems.
  - **Tax Incentives:** Production tax incentives have been introduced in the United States for both the Wind Power and Biofuel industries.
  - **Research and Development Grants:** Significant government investment has been made in research and development (R&D) projects that focus on improving Renewable Energy technology and reducing costs.

BIOENERGY (BIOFUELS AND BIOGAS)

The most recent World Energy Outlook Report issued by the International Energy Agency (IEA) underscored the risks caused by geopolitical uncertainty in the areas where the majority of oil production is concentrated. Although market conditions point to an overall easing of prices, any disruption is capable of pushing them up again. Moreover, increasing demand from developing countries, such as China and India, will put additional pressure on commodity prices. Over the next 25 years, energy demand is predicted to increase more rapidly in the transportation sector than in any other category. Other major risks associated with the high dependence on oil are greenhouse gas emissions and their environmental impact.

For all of these reasons, Renewable Energy can play a key role in replacing fossil fuels as the main energy source, and biomass energy affords some of the best potential for seeking out alternatives. The primary categories of biomass energy are Biofuels, which are aimed at transportation needs, and Biogas, which is an important alternative in the electricity and heat arena.

Biofuels are primarily automotive and commercial vehicle transportation fuels obtained from organic material that can serve as a substitute for conventional fuels, either as total replacements or a partial blend. The most commonly used Biofuel today is Biodiesel, which is made from vegetable oils (such as rapeseed or sunflower oil), animal fats, and restaurant grease that is purified through an esterification process. The other energy source is Bioethanol (commonly called Ethanol), which is derived from sugar and grain crops and obtained through fermentation.

Both Biodiesel and Ethanol fuels are currently manufactured using first-generation technology. However, second-generation Biofuels will rely on cheaper feedstock, such as waste or non-edible materials, so future costs can be reduced significantly. Second-generation fuels are not commercially available yet, and are not expected to reach the market until 2015. In the interim, further research and development is needed to reduce costs and increase efficiency. However, in seven years, these second-generation fuels should offer real cost advantages over traditionally manufactured Biofuels.

Biogas is derived from any organic feedstock, such as crops, plant residue and waste products, via a controlled fermentation process. The byproducts can produce electricity and heat, and may eventually become an ideal substitute for natural gas.

STRENGTHS	OPPORTUNITIES
- Only candidate to replace fossil fuels	- Very low penetration
- Political support	- Rising energy demand from emerging markets
- Cost advantages	- Higher growth for transport sector
WEAKNESSES	**THREATS**
- Amount of arable land available	- Commodity price inflation
- Need for greater financial support	- Adverse climate conditions
	- Competition from other forms of Renewable Energy

INDUSTRY OUTLOOK

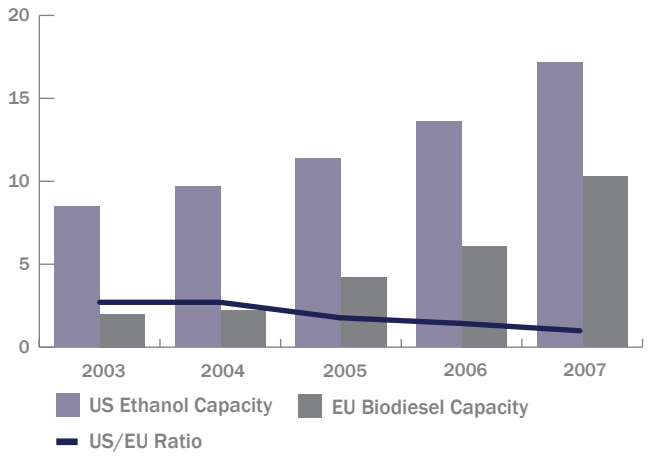
Global energy demand forecasts continue to increase as a result of rising demands in emerging markets. The IEA expects a consumption of 99 million barrels per day of traditional fuel by 2015, and 116 million barrels daily by 2030. The highest growth will derive from the transportation sector, which is projected to account for 68% of increased fuel consumption by 2030. Based on this scenario, fossil fuels will maintain their dominant market position, but forms of Renewable Energy, such as Biofuels, will become viable substitutes.

World production of Biofuel for automobile and commercial vehicle transport is led by United States and Brazil, mainly focusing on Ethanol, whereas Europe is the leading Biodiesel producer. Europe's production of Ethanol is much smaller, primarily due to early adoption of Renewable Energy by other countries and the region's concentration on Biodiesel. Based on an exceptional 60% Compound Annual Growth Rate (CAGR) in the last five years, it appears that global production for both Biodiesel and Ethanol will double again within the next four years.

The combination of an extremely favorable U.S. federal subsidy and an effective prohibition on the use of other oxygenates, such as methyl tertiary butyl ether (MTBE), has resulted in an unprecedented demand for Ethanol. Ethanol production in the United States has grown more than 200% since 2000, and, as a result of increasing demand, imports exploded beginning in 2002. Currently, Ethanol accounts for 2% of the country's total energy consumption. U.S. volumes in 2006 peaked at 15 million tons, representing 36% of the world's production. The U.S. government has supported investments in biorefinery facilities in order to facilitate greater production capacity, and, as a result, this has increased the CAGR by nearly 30% since 2000.

EXHIBIT 1

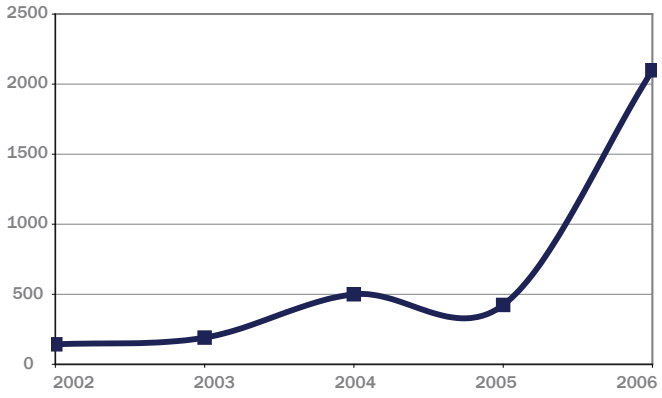
Biofuel Production Capacity
in million tons



Sources: USDA/Renewable Fuels Association-US
European Biodiesel Board, 2007

EXHIBIT 2

U.S. Ethanol Imports
in thousand tons



Source: Renewable Fuels Association, 2006

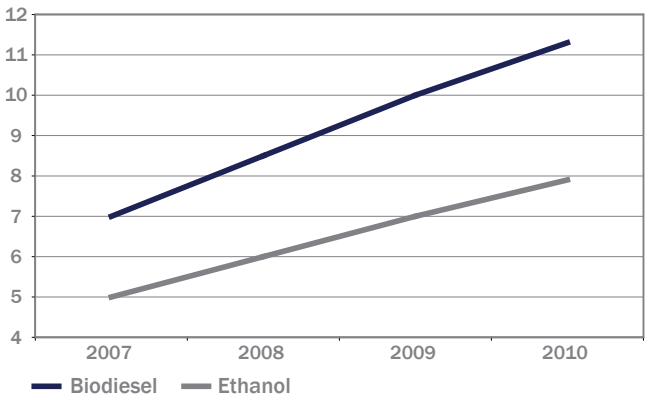
Brazil follows in second place, with 33% of global Ethanol production. The European Union is not a significant player in this arena yet; its 2.8 million tons in 2006 represent just 6% of the total global output. Less arable land, a focus on Biodiesel and a later start explain its lagging position. But the potential for growth remains, as the European Commission forecasts consumption volume will reach 7.8 million tons by 2010. However, in order to satisfy the increasing demand, it is likely that European countries will have to import Ethanol in the future.

World Biodiesel production has grown nearly 300% since 2000, reaching volumes of 2.5 million tons in 2005. Yet, it is still eight times smaller than the Ethanol industry. The largest world producer of Biodiesel is Germany, followed by France and Italy. The U.S. is in the fourth place in the ranking, but the production size is smaller due to the focus on Ethanol. However, imports from the U.S. to Europe could climb sharply in the coming years, as production costs are cheaper overseas due to atractive tax incentives.

In recent years, Biodiesel producers have been increasingly investing in production capacity to satisfy increasing demand. For example, the share of diesel-enabled cars in Europe has been climbing in the last few years and has recently overtaken gasoline. However, European companies could face an overcapacity issue going forward, as it seems that Biodiesel demand has slowed after tax incentives were eliminated by Germany's government. Nevertheless, according to the German Biofuels Industry Association, demand is calculated to grow 26% annually – up to 13.5 million tons – until 2010, almost twice the size of the 2007 estimate.

EXHIBIT 3

EU Biofuel Demand
in million tons



Source: European Comission, 2007

The Biogas market is primarily localized in Europe, with the four biggest producers being Germany, UK, Italy and Spain. In fact, Germany accounts for 70% of global production. As has been the case with all forms of Renewable Energy, growth rates have been impressive in the last years. However, this segment of the market still represents a very small amount of total energy consumption. Biogas is primarily used to produce electricity and heat, but it could be utilized as a viable fuel for transportation needs in the future.

CONCLUSIONS

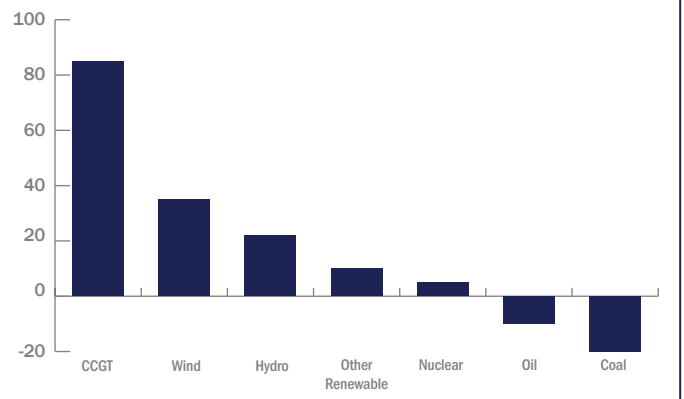
- The United Nations' Food and Agriculture Organization (FAO) forecasts that within the next 15 to 20 years Biofuels will satisfy 25% of the world transportation energy needs.
- The largest developed nations, led by the United States, are investing heavily in R&D, as well as increasing production capacity.
- Based on current market conditions, Ethanol may prove to be more successful than Biodiesel. Sugarcane Ethanol is currently the world's most cost-effective fuel.
- The main beneficiaries of development in the Biofuels sector will be:
  - **Technology developers**, as they will play an essential role in reducing production costs.
  - **Feedstock producers**, as demand of raw materials increases significantly.
  - **Energy producers** that have enough scale and capability for developing commercially available second-generation Biofuels.

- Subsidy policies will, however, prove to be essential until second-generation fuels are available, in order to encourage consumption and competitiveness.
- Biogas prospects are also strongly positive. Production efficiency is even higher than for Biofuels, and has the potential to become the ideal substitute for natural gas. Because of Feed-in Tariffs, Biogas is already a highly profitable sector in Europe.

WIND POWER

Wind Power is one of the more mature sources of Renewable Energy, as the first utility-grade (greater than one megawatt) wind turbines were manufactured 20 years ago. However, it was not until 2000 that the Wind Power sector really started to take off, in response to increasing concerns about climate change and energy shortages in emerging markets, such as China and India. Furthermore, a favorable tax regime in the United States (production tax credits known as PTC's) made the cost of Wind Power competitive with other alternatives. The percentage of new power generation coming from Wind energy over the last decade currently stands at around 24%, just behind Combined Cycle and Gas Turbine Energy (CCGT).

EXHIBIT 4 **New Power Generation - Last 15 Years**
in Gigawatts (GW)



Source: Merrill Lynch Report on Wind Energy, 2007

Because Wind Power is used to produce electricity via wind turbines, detailed information on wind speed and weather conditions at a potential site are vital for subsequent development. Detailed wind "atlases" and the sampling of the wind regime are used before considering any project.

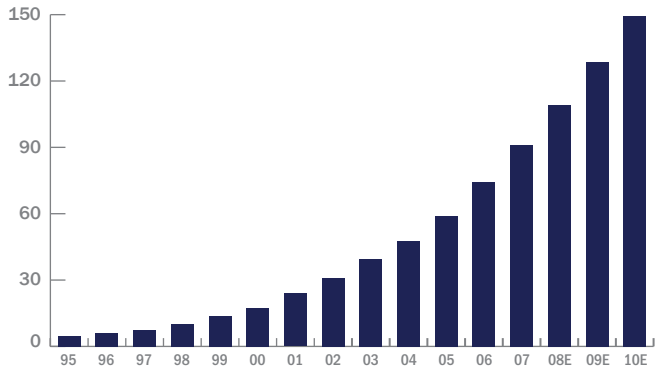
Wind turbines are normally grouped in wind farms located onshore (inland) or offshore. Despite the higher yields of offshore turbines – an average load factor of 38%, versus 28% for onshore turbines – the majority of wind farms are constructed onshore, due to the current high costs of building offshore platforms.

STRENGTHS	WEAKNESSES
- Wind resource is infinite	- Weather fluctuations
- Political support	- Isolated locations of wind farms
- Most available technology	
OPPORTUNITIES	**THREATS**
- Emerging markets demand	- Competition from other forms of Renewable Eergy sources
- Offshore wind farms	- Equipment component shortages

INDUSTRY OUTLOOK

The Wind Power sector is dominated by Europe, which, at present, accounts for 68% of these installations. Germany, Spain and Denmark have all been pioneers in developing this industry, but France, UK and Italy are now joining their ranks. In the United States, the wind industry is taking off again after a sharp slowdown in 2002 and 2004, when political support all but disappeared. However, U.S. policymakers realized that subsidies were necessary in order to encourage the companies to invest in this sector. As a result, the U.S. government introduced new tax incentives that have been extended until 2008. Emerging markets have also played an important role, because energy shortages make developing new alternative energy sources increasingly important.

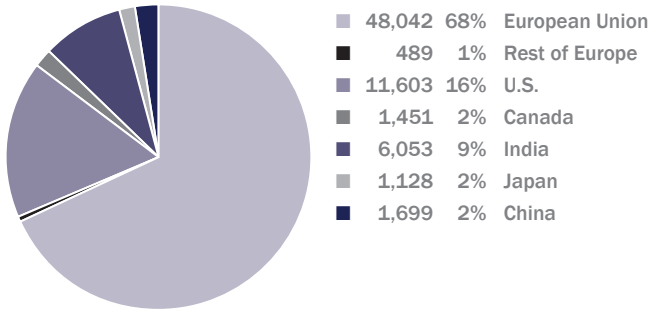
EXHIBIT 5 **World Wind Capacity**
in thousand Megawatts (MW)



Source: Global Wind Energy Council, 2007

Global Wind Power capacity has been growing at an impressive 25% CAGR during the last 10 years and is expected to maintain a solid pace for the next four years. Some countries have experienced even higher growth rates for Wind Power, as a result of a more stable regulatory environment and easier access to financing.

EXHIBIT 6 **Installed Capacity Market Share**
in Megawatts (MW)



Source: Global Wind Energy Council, 2007

The Global Wind Energy Council (GWEC), forecasts an average annual growth of 19% until 2010, when installed capacity might peak at 149 gigawatts (GW) – more than double present capacity. The share of installed capacity will be more equally distributed, as some European countries are showing signs of saturation, and the U.S. is undergoing an expansion phase.

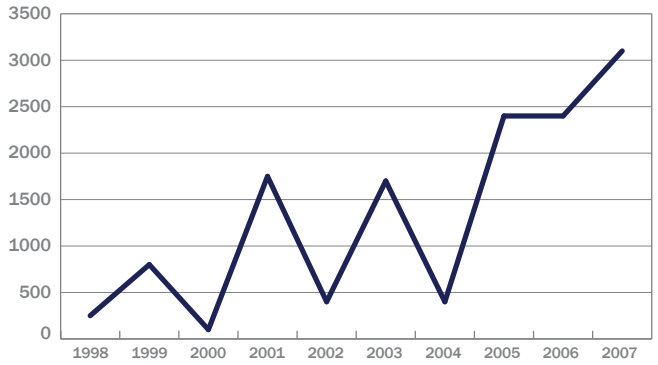
From a regional perspective, Europe represents the strongest market for Wind Power. Power-generation capacity has grown at a CAGR of 30% over the last 10 years, and there are no signs of a slowdown. Furthermore, the European Union set a 40,000 Megawatts (MW) target for 2010, which has already been met. By the end of 2006, installed capacity had reached 48,062 MW, representing nearly 3.3% of the European Union's electricity consumption.

The European Wind Energy Association forecasts that installed capacity in Europe will reach 100,000 MW, representing a CAGR of 25% from 2007 to 2010. Growth will be mainly driven by the UK, France and Italy, each increasing by approximately 4,000 MW during that period.

The European Wind Energy Association has set targets for 2020 that show the importance of wind energy in shaping the future of the electricity supply system. By 2020, it is expected that Europe will have an installed capacity of 180 GW and an output of 500 Terrawatts (TWh), representing between 13% and 16% of total electricity consumption. Environmental benefits will translate into 370 million tons of emissions savings.

The U.S. Wind Power market ranks in third place globally, lagging Germany and Spain. Growth rates have been impressive at a CAGR of 30% since 2000, but not very consistent, due to spotty regulatory enforcement. Tax credits were eliminated twice, and this also sharply curtailed investment. Currently, the U.S. government intends to heavily promote Renewable Energy to satisfy increasing demand and to reduce dependence on foreign energy suppliers.

EXHIBIT 7 **U.S. Annual Installations**
in Megawatts (MW)

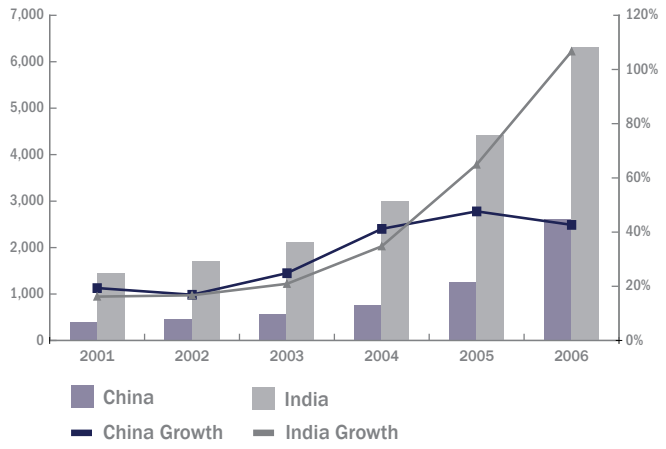


Source: American Wind Energy Association, 2007

Finally, emerging markets, such as China and India, are playing an increasingly significant role in the Wind Power industry. These economies are undergoing a boom phase, and their energy needs have multiplied, so it has become essential to invest in different energy sources.

India currently has the fourth-largest installed capacity of 6,300 MW, and some studies have shown that the potential for Wind Power in that nation could be as much as 65,000 MW. Prospects for China are even more staggering. Although current production capacity is 2,604 MW, the Chinese Meteorology Research Institute has stated that the potential for power generation is 253 GW.

EXHIBIT 8 **Emerging Markets**
in Megawatts (MW)



Source: Global Wind Energy Council, 2007

CONCLUSIONS

- Wind Power resources are virtually infinite, so they are not affected by inflationary pressures.
- Although some companies are already profitable, government support is essential to encouraging development of this industry.
- Global warming concerns and increasing demand for electricity in emerging markets make this form of alternative energy a viable solution.
- Wind Power is a completely clean energy, as CO_2 emissions are zero.
- International organizations forecast a minimum of double-digit growth rates for the sector until the end of the decade.
- The main beneficiaries of the developing Wind Power sector will be:
  - **Wind Turbine Manufacturers**, as this represents the basic and essential component of the conversion process. The more vertically integrated the production capabilities are, the greater the advantage for manufacturers.
  - **Key Component Suppliers**, (rotors or gearboxes), because some Wind Power manufacturers have an inadequate production capacity and need to outsource these elements.
  - **Weather Instrument Providers**, as analysis of weather conditions and wind speed is vital in order to initiate any project.
  - **Land Owners**, because adequate sites are of key importance.
- Electricity providers might benefit when the component shortage issue is resolved, although this is not expected to occur until 2009.

SOLAR POWER

The prime drivers of the Solar Power sector are exactly the same as those behind other Renewable Energy sources, i.e., concerns about global warming and over-dependence on oil.

At present, there are two main technologies available for producing energy from sunlight – Solar Thermal and Photovoltaic (PV) technologies.

Solar Thermal technology uses the sun's radiation to produce energy, heat water, raise the temperature in buildings and create steam for electricity generators. Although this is technically an "old" technology that was introduced hundreds of years ago, utility-grade Solar Thermal technology is now growing increasingly more sophisticated. At the retail level, Solar Thermal technology is used to directly heat water in many parts of the world.

Four elements are needed to produce Solar Thermal energy:

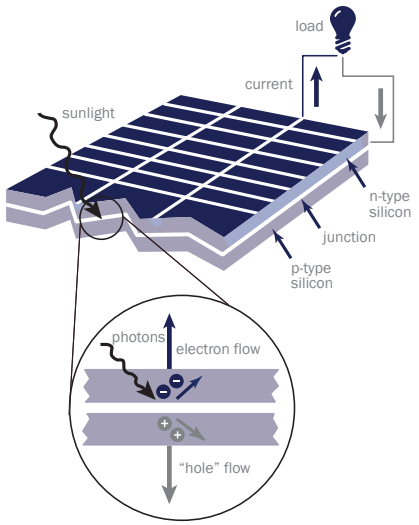
- A **solar collector**, normally a set of mirrors, that collects the solar radiation and focuses it onto the solar receiver.
- The **solar receiver** that transforms the radiation into heat.
- A **heat storage system** to maintain the heat until it is needed for conversion.
- An **energy conversion system** that converts the heat into electricity.

Photovoltaic solar energy produces electricity from sunlight by using a semiconductor material – mainly silicon. Several silicon cells are grouped into blocks called modules, and when light touches the PV cells, the electromagnetic field produces electricity.

There are three types of Photovoltaic systems:

- **Grid Connected:** The PV system is connected to the utility network, which stores the energy.
- **Off-grid:** There is no grid connection. The electricity is simply stored by a charge controller, which is connected to a battery.
- **Hybrid System:** Different power systems are combined to guarantee a continuous electricity supply.

EXHIBIT 9 **Photovoltaic Technology**



Source: Research Institute for Sustainable Energy, Australia

STRENGTHS	WEAKNESSES
- Sunlight is an abundant resource	- Sunlight is not always available
- Political support	- Current high production costs

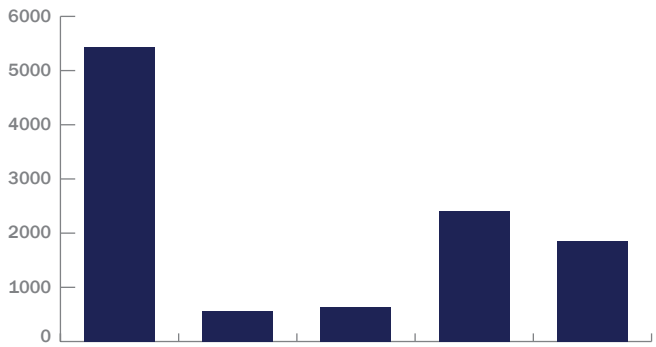
OPPORTUNITIES	THREATS
- U.S. market potential	- Regulatory risks
- Improvements in manufacturing leading to cost reductions	- Competition from other forms of Renewable Energy

INDUSTRY OUTLOOK

The Solar Power sector has been booming over the last four years. Despite high growth rates, it is still in its infancy compared to other forms of Renewable Energy, such as Wind Power or Hydro Power, so further double-digit growth is expected to continue through the next decade. However, the degree of market penetration varies within the different technologies.

According to a study done by the European Photovoltaic Industry Association (EPIA) and Greenpeace, member countries of the Organisation for Economic Co-operation and Development (OECD) will continue to dominate the solar industry for the next five years. However, as production costs decrease and the price of silicon declines, the importance of both South America and African countries will grow significantly.

EXHIBIT 10 **Country PV Capacity**
in Megawatts



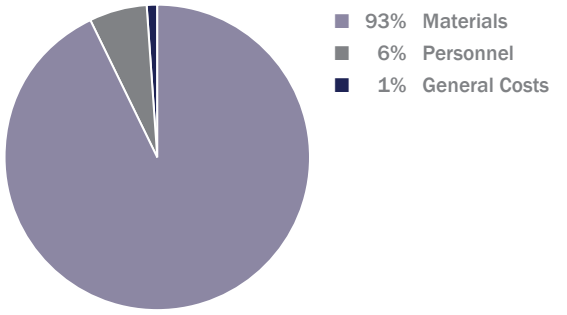
Source: EPIA/ EurObserver, 2006

In terms of production costs, electricity and heat obtained from Solar Energy is currently the most expensive of all the sources available. As a result, this form of Renewable Energy needs to be highly subsidized to be cost-effective. Although R&D investments are reducing costs and increasing efficiencies, solar power won't be in the same category with other Renewable Energy technologies until the end of the next decade.

Comparing both technologies, Solar Thermal appears cheaper than Photovoltaic, because of the type of materials used and the fact that it is a much simpler technology. However, Solar Thermal energy is obtained from heat directly from the sun, whereas PV technology requires transforming sunlight. So the potential for the latter is greater, because Solar Thermal panels must be located in well-sunlit areas.

An important aspect to consider is the components used to build the solar systems. For Solar Thermal panels, the largest cost is related to the materials that are part of the production process. The most common components are glass, steel and concrete, although no silicon is used. Despite recent inflation in steel prices, production costs are lower than those for Photovoltaic cells.

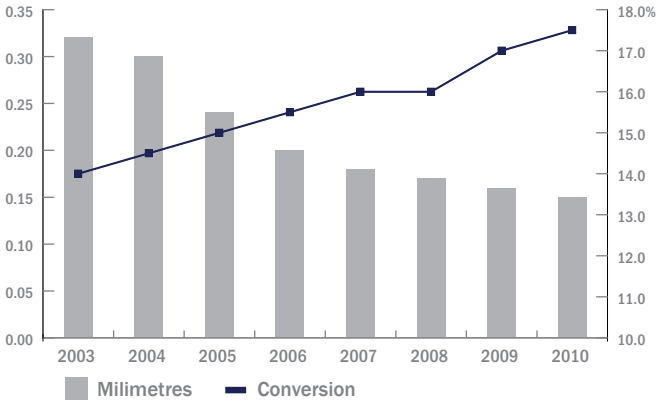
EXHIBIT 11 **Solar Thermal Panel Costs**



Source: Solaria Presentation to Institutional Clients, 2007

The Photovoltaic production process is a highly cost-intensive process as a result of silicon prices and the material losses realized as part of manufacturing. However, a new method is increasingly being adopted that uses thin film cells. Thin layers of photosensitive materials are deposited on a low-cost backing, and so the amount of semiconductor material used in the overall process is much lower. As technology advances, it is anticipated that thinner wafers will lead to higher efficiencies and further cost reductions.

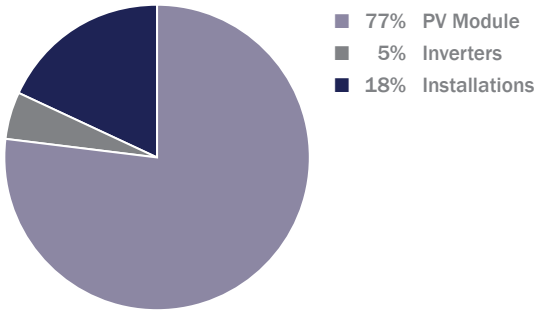
EXHIBIT 12 **Cell Efficiency**



Source: European Photovoltaic Industry Association, 2007

The importance of module production costs is essential, as it represents 77% of total equipment costs. Inverters, which are used to convert continuous current into alternative current, represent 5% of total costs. The remaining 18% is related to other components and the assembly of the unit.

EXHIBIT 13 **Photovoltaic System Cost Structure**



Source: Solaria Presentation to Institutional Clients, 2007

Today, silicon is the basic material used in the production of the cells that compose the modules installed in solar-panel roofs. This represents the largest cost involved in the solar cell production process.

Clearly, reduction of wafer costs is of vital importance, because the increase in demand has not been accompanied by a parallel increase in silicon production. This has led to a shortage, and, as a consequence, prices have risen quite dramatically. Even in the best-case scenario, it seems that these shortage problems won't ease until 2008. At this point, the main beneficiaries are the silicon and cell producers along the supply chain. However, looking at the prices of modules in the last months, it seems that after a sharp increase since 2005, inflationary pressures have eased.

CONCLUSIONS

- Solar Power technology is improving, making this a more commercially viable option in the future.
- The European Photovoltaic Association forecasts high double-digit growth for this sector over the next decade.
- Government support will remain the main driver of industry growth. This is of significance, as it will take at least a decade to reduce costs and to make the technology competitive.
- Availability of sunlight and non-dependence on oil make this form of energy an ideal candidate for contributing towards emission-reduction targets.
- A highly diversified customer profile of both individuals and businesses for solar energy will allow providers to deliver more stable earnings, although sensitivity to economic cycles will remain an important factor.
- Although solar thermal technology is expected to continue growing at double-digit rates, it is likely that in the short-term the technology will be used primarily for domestic heating purposes, especially for heating individual households.

Chantal Brennan joined AIG Investments in 1996 and is the Head of the European Smaller Companies Team based in London, Deputy Head of European Equities, and Product Head of International Small Cap. Prior to joining AIG Investments, she served as a Research Analyst with Standard Life Assurance Company in Scotland. Ms. Brennan received Bachelors and Masters degrees in Economics from University College Dublin and a Masters of Science in Investment and Treasury from Dublin City University. She is a member of the UK Society of Investment Professionals and the CFA Institute.

Patricia Tomás García joined AIG Investments in 2007 as a Research Analyst with the European Small and Mid Companies Team based in London. She was previously a Research Analyst with Belgravia Capital, an asset management company in Madrid. Ms. Tomás García received Bachelors degrees in Business Administration and Law from Pontificia Comillas University at Madrid. She is a Level 1 CFA candidate.

70 Pine Street NY, NY 10270

AIG Investments℠

800.706.6661 www.aiginvestments.com