Changing Climate in the Energy Sector –

a new Wave of Sustainable Investment Opportunities Emerges

sam sustainable asset management

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Executive Summary

Several trends are currently giving the world-wide energy market a new focus. Central to this change are the **liberalization** of electricity and gas markets, the increasing importance of **environmental awareness** and **climate policy,** and the **growing demand for energy** in emerging economies. The challenge to companies lies in responding promptly to the new requirements, perceiving them as an opportunity and offering innovative sustainable technologies and services. We identify four market areas that are profiting from all three trends and can be expected to grow at an attractive rate – renewable energy, distributed energy systems, natural gas and demand-side energy efficiency.

Renewable energy sources are practically CO_2-free and available in large quantities. While today we use mainly hydropower world-wide as a commercially viable source of renewable energy, wind energy and geothermal energy are also advancing towards competitiveness. With regard to photovoltaics (solar energy), the challenge lies in reducing costs. Wind and solar energy are experiencing the highest growth rates of around 25% p.a. Focussed small and medium-sized businesses offer an increasing number of investment opportunities.

Distributed energy systems will replace more and more of today's centralized supply structure as a result of the break-up of monopolies. Certain technologies are also suitable for energy supply in emerging economies without any existing grid infrastructure. Thus electricity production is moving closer to users, allowing for additional use of heat and increasing security of supply. In addition to micro turbines and fuel cells, new storage technologies and power electronics systems will also profit.

Natural gas will play an important role in the medium term as it is the least CO_2-intensive fossil fuel. Replacing coal with natural gas is therefore an effective step towards reducing climate problems. In addition, natural gas is the fuel of choice for many distributed energy technologies. World-wide consumption of natural gas will rise by more than 35% by 2010. There are opportunities to invest at various stages in the value chain, from efficient gas production processes and transportation to Independent Power Producers (IPPs).

Demand-side energy efficiency is the fourth field offering sustainable growth opportunities. Attractive investment opportunities are to be found in Facility Management, i.e. innovative technologies (heating systems, new materials) and services (contracting, energy management systems) for the efficient use of energy in buildings. The mobility sector also offers opportunities to increase energy efficiency profitably, in particular in the context of new vehicle concepts such as fuel cell and hybrid electric vehicles.

By focusing on these four **sustainability clusters** and analysing the **value chain** within the clusters, SAM has developed an innovative and comprehensive investment strategy for sustainable energy. Selected companies in these four emerging fields stand out as they simultaneously create added economic, environmental and social value, the basis for long-term success.

Sustainable Energy Investments

Contents

Sustainability is the key to successful energy investments

"High level of inefficiency in the energy market"

Increasing relevance of sustainable energy systems

The energy market is a multi-billion dollar market. The US electricity market alone, with an annual turnover of $218 billion, is significantly larger than the entire telecommunications sector. Therefore, each market share of one per cent that any company can secure is worth over $2 billion. And electricity spending accounts for only around 38% of the entire energy market. Other forms of energy such as fuels for transport and heating, batteries for mobile telephones and laptops etc. account for a further $350 billion of turnover in the USA or around $1,400 billion world-wide. These huge energy costs do not include the additional market volume of technologies, products and services for energy conversion and use. However, the efficient use of energy in particular offers enormous potential. Losses in the energy chain – from primary energy sources, conversion and transportation to consumption by users – amount to around 70%. Therefore, energy worth around $1 trillion goes unused world-wide every year.

"The relevance of sustainable energy systems is increasing"

Energy is one of the basic resources for prosperity, security and independence. Energy moves people, drives machines, supports access to information, enables food preparation and heats and cools rooms. Almost no other industry, perhaps with the exception of water and food, faces such secured long-term growth and, at the same time, is as important for our future development as the energy market. However, the current provision and use of energy is associated with considerable effects and consequential costs for the environment and humankind. During the twentieth century world-wide consumption of fossil fuels increased by 3,140%. At the same time, there are still two billion people who are not connected to the electricity grid and a further two billion who consume per capita just a tenth of the energy required by the average US citizen. As a result, radical change in the energy market is in sight. This change is also being brought about by the reorganization of electricity and gas markets in almost every industrialized nation. Promptly identifying the trends and driving factors behind this change and understanding its effects forms the basis of a successful investment strategy.

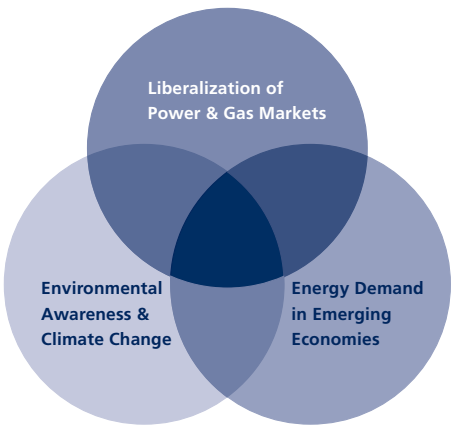
Tomorrow's winners will be those companies that respond to the new market requirements, perceive them as an opportunity, help to define the new parameters and achieve a competitive edge early on. As this study clearly illustrates, the provision of "sustainable" technologies and services forms the basis of long-term success. The players in the sustainable energy market will not only be traditional energy companies but providers of intelligent new technologies and services – market success will no longer be measured in gigawatt hours and billions of barrels but in increasing added value created as customer needs are satisfied in an energy-efficient manner.

Trends that are redefining the energy market

Various trends and factors currently determine developments in the energy markets. Central to these developments, three in particular are having a significant long-term impact on the energy sector.

- **Liberalization** of the gas and electricity markets
- Increasing demand for energy in **emerging economies**
- Increasing pressure as a result of **environmental awareness and climate policy**

Figure 1



Source: SAM/CERA

Figure 1: The key trends

"Decreasing optimum plant size and growing market transparency and efficiency"

Liberalization of the electricity and gas markets

The long-maintained and strictly regulated structure of the electricity market was based on the theory that large, centralized power plants represent the most efficient form of electricity production. Large power plants, vertically integrated with transmission and distribution networks, were supposed to bring about better economies of scale and lower costs than smaller independent plants. Government authorites regulated prices and investments in what was supposed to be a natural monopoly. Several factors led to the current revision of these market structures and the introduction of open market principles.

Positive experiences in other industries

Here, the experience of the liberalization of other strictly regulated markets such as telecommunications and air transport played an important role. This experience showed that, where the appropriate market structure is chosen, new players join the competition, competitive pressure increases and consumers enjoy a better selection of products, services and, as tends to be the case, lower prices. Newcomers were usually able to adjust and develop better and faster than the established suppliers. The level of innovation provided by newcomers is reflected in the inflow of venture capital into a liberalized industry.

Technological progress

Another factor supporting market liberalization is the major technological progress in electricity production, transmission and use. Particular in gas turbines and combined heat and power generation, technological progress has reduced quite considerably the optimum size of power plants with regard to the economies of scale to be achieved in operations. At the same time, innovative new technologies with a smaller power range have been simplified and today achieve economies of scale at the manufacturing level through mass production. Therefore, it is no longer necessary to build a 1,000-megawatt power plant in order to achieve competitive pricing. Combined cycle power plants reach maximum efficiency at 400 megawatts and gas turbines with smaller specifications at as little as 10 megawatts. This trend is also reflected in the typical size of new power plants built today. Between 1996 and 2000, the average in the USA was 65 MW.

In addition to changes in power plant technology, deregulation is also supported by innovation in information and communications technology. This enables the provision of real-time data about supply, quality, demand and bottlenecks, which is a prerequisite for an efficient wholesale market. This also offers retail customers the opportunity to choose their electricity supplier directly over the internet, and it also supports information flow between customers and suppliers regarding the quantity and quality of electricity purchased and therefore makes administration and clearing easier.

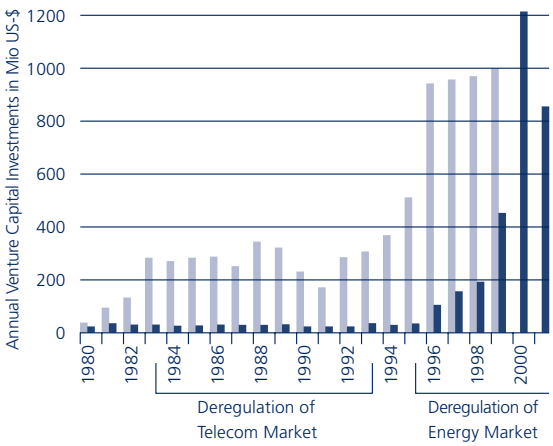
Horizontally integrated players

The process of market liberalization leads to the break-up of monopolistic, vertically integrated structures and creates a market-driven environment. In

Figure 2:
Innovative activity of new players in liberalised markets

Figure 2
Flow of Venture Capital in Deregulated Industries (1980–2001)

Source: SAM/Nth Power/ Venture Economics



Increase in Innovative Activity in the Deregulated Energy Market

Source: P. Tertzakian

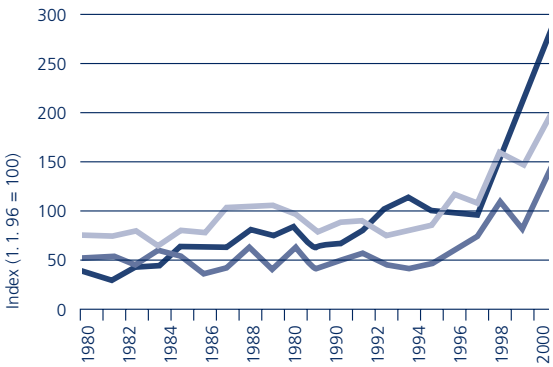
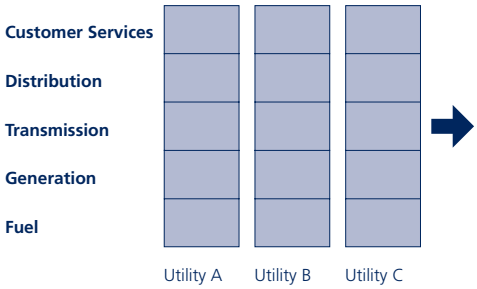


Figure 3:
From vertical to horizontal integration

Figure 3

The Old Vertically Integrated Power Industry



The New Horizontal Electric Power Industry

Quelle:CERA

Energy Services	Utilities	Facility Mgmt.	Service Prov.	?
Sales/Marketing	Utilities	Aggregators	Marketing	?
Billing/Metering	Utilities	Telep.	Credit Card	Metering
Distribution	IOU's	Co-ops	Non-Utilities	?
Transmission	Utilities	ISO's	Merchants	?
Power Marketing	Utilities	Power Marketers		?
Generation	Utilities	Wholesale	Self Generat.	?
Fuel	Producer	Marketers	Services	?

Great Britain, Scandinavia, Australia and Germany, this process of change is already at an advanced stage while in other countries such as France and Switzerland it is only just beginning or political negotiations are taking place. In the USA the process of deregulation has slowed down somewhat in California in the wake of the electricity crisis in the summer of 2000 and the Enron bankruptcy, while other states such as Texas and Pennsylvania have successfully opened up their markets.

Distributed increase in capacity

In addition to the emergence of new players such as Independent System Operators (ISOs), Independent Power Producers (IPPs) and Regional Transmission Organizations (RTOs), there is also evidence of substantial shifts within existing groups. The volume of electricity produced by non-utilities rose by 27.5% between 1998 and 1999 compared with a fall of 1.2% in production at conventional utilities. Increases in capacity provide even stronger evidence of this shift. In 2000 non-utilities accounted for 69% of newly created capacity. This is particularly interesting as non-utilities tend to operate smaller plants, another indication of the shift towards new, smaller and distributed technologies.

Process of consolidation and convergence

In contrast, there are indications of a consolidation process among established utilities, as well as a convergence of the electricity and gas markets. In 1992, the 10 largest "Investor-owned Utilities" (IOU) in the USA held 36% of the private market. Today, this figure has risen to 51%, and the 20 largest companies together control 72%.

Increasing price volatility

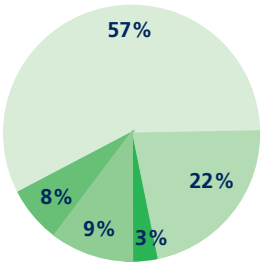
Another effect of market liberalization that cannot be ignored is increasing price volatility. Although falling prices can be assumed in most markets, price fluctuations are increasing at the same time. A comparison of these price levels with the generation cost of new energy technologies such as wind turbines, micro turbines or fuel cells clearly highlights the falling barriers to market entry and growing competitiveness. However, the increasing volatility and associated costs also show the growing need for technologies and players that create a more efficient market and avoid or bypass supply bottlenecks.

Figure 4:
The changing shape of the US power market

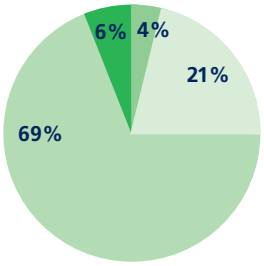
Figure 4

Source: EIA/DOE

Net Production 2000 (7240 Mio. MWh)



Added Capacity 2000 (27822 Mio. MW)



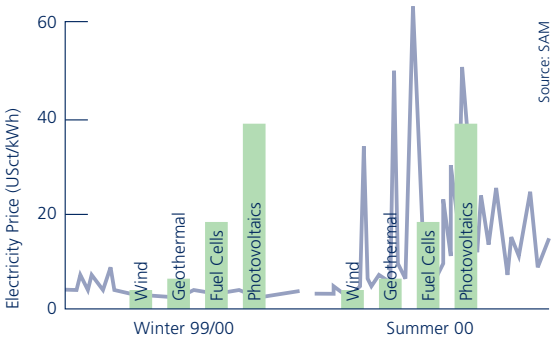
Conclusion for investors

The liberalization of the electricity markets leads to new structures, parameters and players. Subsequent opportunities for investors occur in the following areas in particular.

– The generation structure is shifting from large, centralized energy systems to distributed, smaller units, thereby opening up enormous growth opportunities for these specific technologies.

Figure 5:
Increasing price volatility in California vs. generation cost of new power technologies

Figure 5



- Where prices are volatile, sustainable distributed energy technologies become financially attractive and can make a considerable contribution towards bypassing supply bottlenecks.
- Liberalization increases market transparency and flexibility, which leads to growing demand for specific measurement, information and communications technology.
- Growing price volatility increases the need for products and players that create an efficient and liquid gas and electricity market.
- Electricity and gas markets are converging. Merger and acquisition activities continue as part of sector-wide consolidation.

Energy demand in emerging economies

Per capita consumption still lower

The OECD countries account for more than 60 % of the energy consumed world-wide. Around 90 % of the energy used here comes from emission-intensive, fossil, non-renewable energy sources such as coal, crude oil and natural gas. Measured in terms of the population of 1.1 billion in the OECD countries, this represents consumption of 3.15 tonnes of crude oil per person per annum.

In contrast, the data in non-OECD countries show quite a different picture. 81 % of the world's population (non-OECD) account for 47 % of energy consumption. Per capita consumption is lower by a factor of 7 on average in non-OECD countries than it is in North America. However, the growth rates are much higher and energy use is not nearly as efficient.

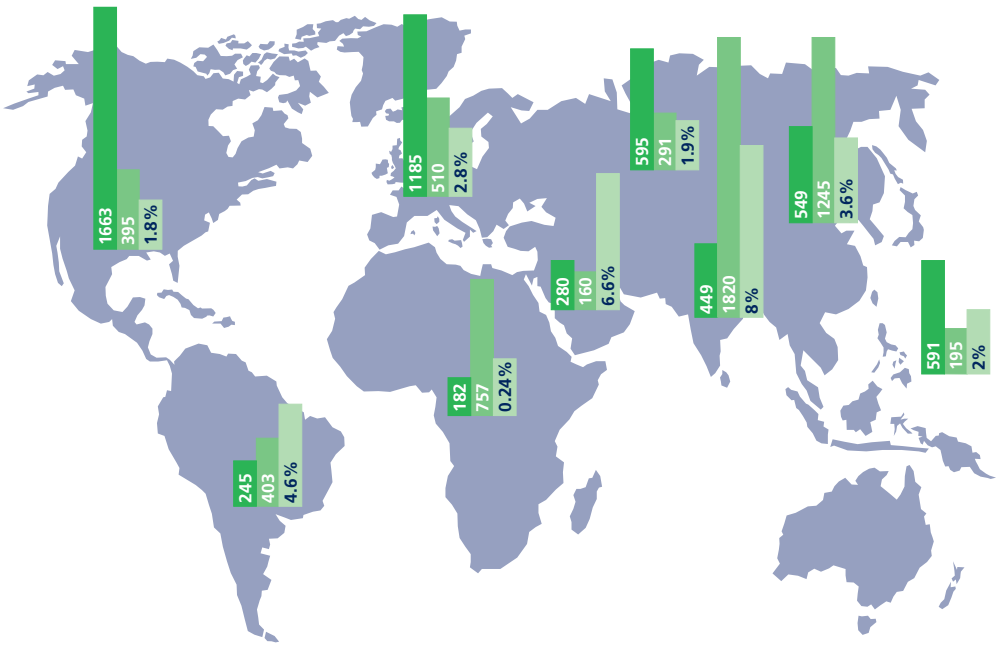
In comparison with the OECD (with growth of 13 % between 1990 and 1998), energy consumption in Asia, for instance, rose by 44 %.

The main driving forces in these "emerging economies" are population growth and increasing per capita energy consumption. In Asia alone the population has grown by more than 400 million people over the last 10 years, i.e. by more new potential energy

Figure 6:
Regional differences in energy consumption and demand growth

Total Energy Consumption (toe)
Population (Mio.)
Electricity Demand Growth

Figure 6



Source: SAM, Data IEA/OECD

"Highest growth rates in the electricity and mobility sector"

"Dilemma between economic growth and sustainable development can only be solved using energy-efficient technologies"

"Lack of infrastructure and high set-up costs encourage distributed energy systems"

customers than the entire population of North America. At the same time, per capita consumption is growing rapidly. Rising income as a result of a growing economy is reflected in particular in the demand for electricity and mobility.

Strong mobility growth in China

Today, per capita energy consumption for mobility is lower by a factor of 10 to 15 on average in emerging economies than it is in industrialized regions. An exceptional example is China, where just 6% of total energy consumption is used for mobility (OECD average is 33%). Correspondingly, per capita mobility-related emissions rose by a substantial 35% between 1990 and 1995. If population growth is factored in, the increase in absolute terms comes to 48%.

Above-average demand for electricity in Asia

The electricity sector shows a similar picture. In China and Asia emissions resulting from electricity production rose by 72% and 53% respectively between 1990 and 1995, corresponding roughly to the growth rate of demand for electricity. Nevertheless, Asia, with electricity consumption of 509 kWh per capita compared with North America's 10,771 kWh or Europe's 6,592 kWh per capita, is at the lower end of the scale.

Lack of infrastructure

Many regions in emerging economies have no or only insufficient infrastructure in contrast to the well-established and networked electricity distribution infrastructure that has been in place in industrialized nations for decades. At the same time, they are often unable to finance expensive national grids. This discrepancy, and the rapidly growing demand for electricity, leads to attractive new markets for distributed energy technologies. As this coincides with high fossil fuel prices, products that use renewable energy sources will profit greatly.

Sustainable development perspective

The high energy growth rates that can be expected lead to a further dilemma for many emerging economies. An increase in per capita energy supply leads to a higher standard of development, a positive correlation with the Human Development Index (HDI) and increasing wealth. However, local emissions quickly rise and can reach hazardous levels. Under these conditions, development can only be sustainable if new and efficient energy technologies are applied. One factor that can support such development is the Clean Development Mechanism (CDM) agreed in the Kyoto Protocol. This facilitates investment in low-emission energy technologies in non-annex countries (emerging economies), financed by industrialized nations. The industrialized nations are then credited the emissions reduction generated through their investments, allowing them to meet their emission targets at lower costs. From the perspective of climate problems, it does not matter where emissions reductions are achieved since the problem of CO_2 emissions is a global one.

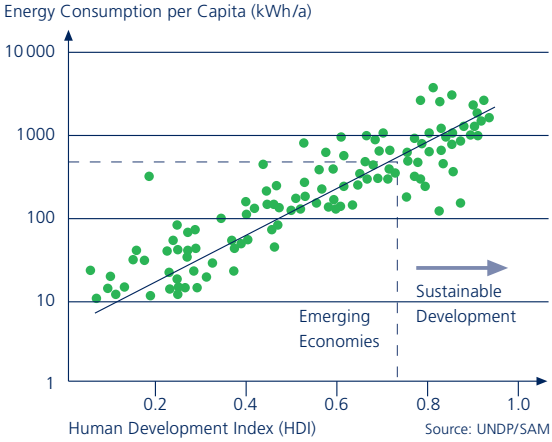
Conclusion for investors

The continuing trends in emerging economies of high population growth, strong economic growth and increasing per capita demand for energy are mutually reinforcing and lead to a rapidly expanding energy market. These developments result in the following opportunities for investors in particular:

- Distributed energy technologies profit from rapidly increasing demand for electricity and the lack in the medium term of national electricity grids in certain regions of the world.
- While fuel costs are high, demand will be high for distributed energy technologies based on renewable energy sources.

Figure 7:
Human Development Index and per-capita energy demand

Figure 7



"The competitive advantage of renewable energies does not primarily result from limited fossil resources"

– At the same time, increasing demand, combined with the negative effects of local emissions, encourages the use of energy-efficient, low-emission technologies.
– Low-emission energy technologies are considered to be attractive investments for industrialized nations in conjunction with the "Clean Development Mechanism".

Environmental awareness and climate policy

The preservation of the environment and nature, further economic development and the safeguarding of a sufficient resource base for coming generations represent a fundamentally interconnected triad of goals. However, as a result of the constant technological progress made in exploration methods, new fossil reserves have been tapped and the projected availability of fossil fuels is still high.

Figure 8

Source: SAM/IPCC

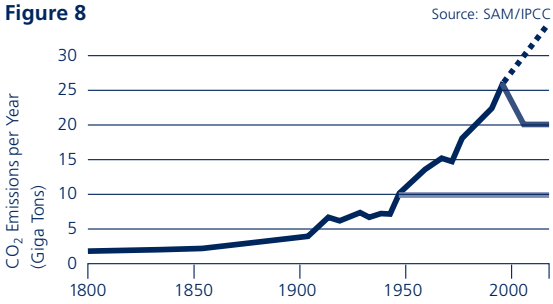


Figure 8:
Historical development of CO_2 emissions and requirements of the Kyoto Protocol

- CO_2 Emission Forecast "Business as Usual"
- CO_2 Emission Forecast under the Kyoto Protocol
- Max. Emission Level for a Sustainable Development according to Intergovernmental Panel on Climate Change (IPCC)

The most urgent problem is not therefore limited fossil resources, even if these fuels currently cover around 90 % of the world's energy requirements, but the emissions of air pollutants that result from the consumption of fossil fuels. At a global level, greenhouse gases and the related climate problems make a new attitude and response to the problems inevitable. In contrast, at a regional level, it is the pollutants that harm man and the ecosystem, leading to health consequences.

International climate policy

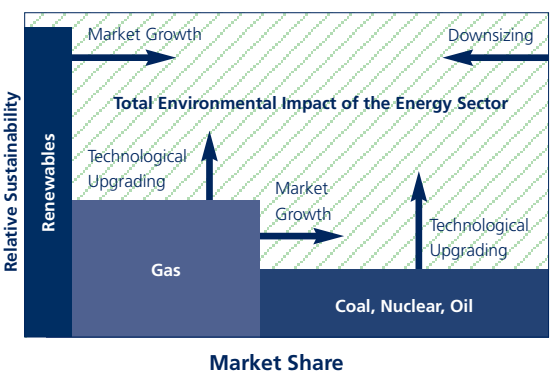
Over the last two decades, governments and society have become increasingly aware of these complex interrelationships and developed a growing number of concrete measures and programmes aimed at reducing harmful emissions. At an international level, these efforts culminated in the signing of the Kyoto Protocol in 1997 by more than 150 countries. The protocol envisages a 5 % decrease in industrial nations' greenhouse gas emissions by 2010 as compared with 1990 levels. Contrary to the current trend, this demands reduction targets of up to 40 % (figure 8). Although the USA has withdrawn from the Kyoto process, 74 countries representing some 35 % of global emissions have already ratified the Protocol by June 2002.

Strategies to reduce environmental impacts

Generally, we identify three strategies that lead to a reduction in environmental impacts. These are derived from the "Sustainability Roadmap" (figure 9). The various energy sources with their current market share and specific environmental damage (or relative environmental quality) represent the starting point.

If the energy market is analyzed by the market share and environmental quality of the products on offer, we identify three segments. Renewable energy sources (left-hand side) show the highest environmental quality (lowest environmental damage) but currently have only a small market share. At the other end of the spectrum are conventional energy sources such as coal, oil and nuclear energy (right-hand side) showing low environmental quality but a large market share. Natural gas forms the middle segment as, in comparison with other fossil fuels, it is relatively environmentally friendly. Natural gas emits an average of 270 kg CO_2 for every MWh produced compared with 310 kg from oil or 400 kg CO_2 from brown coal. Seen from this perspective, the surface sketched on the roadmap measures the total environmental damage caused by the energy sector. This will be reduced by:

Figure 9



Source: Wüstenhagen/Meyer/Villiger, SAM

Figure 9:
Strategies to reduce environmental impact: „Sustainability Roadmap"

"Emission certificates increase the profitability of low-emission energy technologies"

– growth of market segments with higher environmental quality (arrow pointing right),
– technological upgrading within the segments (upward arrow), or
– downsizing of the entire market volume (arrow pointing left).

The Sustainability Roadmap illustrates paths towards a sustainable energy future.

Implications of reductions

The ratification and implementation nationally of climate reduction guidelines such as the Kyoto Protocol will lead to significant implications in the energy markets. According to studies by the International Energy Agency (IEA), if 70 % of the Kyoto reduction guidelines were met in the USA for instance, this would result in substantial shifts in electricity production. CO_2-intensive coal would be replaced to a considerable extent by less CO_2-intensive natural gas. The contribution of natural gas to overall electricity production would rise from 15 % at present to 50 % in the year 2010 (figure 10).

Figure 10

Source: IEA / DOE

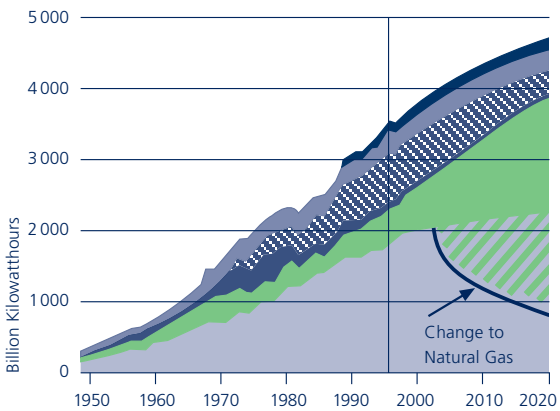


Figure 10:
Implications of the Kyoto Protocol for US electricity generation

Incentives

Although the Kyoto Protocol has not yet been ratified by all nations, a number of countries have already set their own reduction targets at a national level and introduced financial instruments in order to ensure that goals are attained efficiently. The instruments include creditable emission reduction investments and trading platforms for emission certificates. Reduction and substitution investments can be expected in relatively emission-intensive segments such as coal-fired power plants. According to current estimates, the emission credits or certificates gained through these investments will be worth between EUR 5 and 20 per reduced ton of CO_2 and can therefore have a noticeable influence on the profitability of the technology used. In addition to natural gas technology, the use of renewable energy sources in particular guarantees a large reduction in emissions, thereby creating a large volume of emission certificates.

Customer demand for "Green Power"

In addition to regulatory pressure, the growing sovereignty of consumers in liberalized markets also leads to increased consideration of specifically environmental criteria in electricity production. In this context too, one of the driving forces is the liberalization of the electricity market, which allows consumers to clearly state their preferences by deciding to purchase certain products. Surveys and initial experiences in the USA, the Netherlands and Germany show that a number of customers are prepared to pay a premium for electricity of a higher environmental quality.

Conclusion for investors:

Environmental awareness and both national and international climate policy are increasingly prevalent and bring about a relative improvement in the competitiveness of low-emission energy technologies. The strategies to profit from this trend can be deduced from the Sustainability Roadmap. Opportunities for investors therefore occur in the following segments:

– Low-emission energy technologies causing comparatively less environmental damage are growing faster. Renewable energy sources and natural gas are set to profit.
– Technologies that use a fuel more efficiently create both cost advantages through fuel savings and environmental benefits, which get a monetary value through emission certificates. This increases their commercial viability and, ultimately, the demand for low-emission technologies.
– Energy-efficient products and services will also benefit, particularly in segments where energy consumption is a key cost driver.

Investment strategy: Focusing on Sustainability Clusters

"The three portfolio dimensions"

The "SAM Energy Cube" investment philosophy

How should one invest in an energy market that is undergoing radical change and partly determined by still unforeseeable influencing parameters? Finding the right investment strategy means focusing on areas that anticipate market changes but retain their validity over the long term. The SAM energy investment strategy implements these requirements within an innovative and sustainable investment philosophy. Three different dimensions define the investment universe.

1. **The sustainability dimension.**
   This focuses on sustainable energy strategies that are derived from the Sustainability Roadmap and profit the most from the mega-trends illustrated.
2. **The value chain dimension.**
   This prevents a one-sided focus on what are clearly today's core technologies without consideration of upstream and downstream players, enabling technologies and services in the value chain.
3. **The company diversification dimension.**
   This indicates diversification within the portfolio in terms of the companies' size and market capitalization.

Figure 11

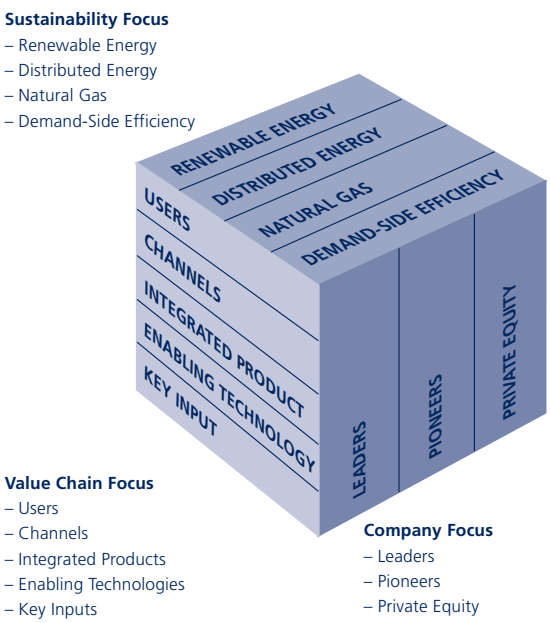


Figure 11:
Three-dimensional investment strategy to define a sustainable energy portfolio
„SAM Energy Cube"

The integration of these three dimensions – sustainability, value chain and company diversification – to form an investment strategy results in the SAM Energy Cube. It reflects the SAM investment strategy from three different perspectives and shows how investment is distributed strategically.

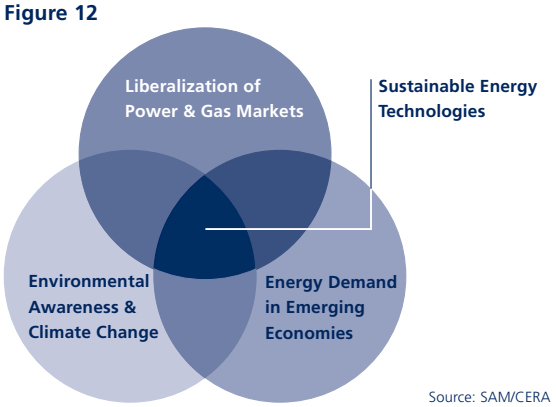
"Sustainability" dimension

The three major trends – market liberalization, environmental awareness/climate policy and growing demand in emerging economies – are becoming increasingly important and resulting in massive changes in the world's energy markets. Companies that do not respond to these changes now will lose market value over the medium term. In contrast, players who perceive all three trends as an opportunity show great upside potential. As the analysis of the three trends illustrates, sustainable energy technologies in particular profit the most from these changes. Therefore, SAM believes that the key to a successful energy portfolio lies in focusing on sustainable energy technologies and services.
Sustainability Clusters are based on a sustainable energy strategy that reduces environmental impacts (Sustainability Roadmap). At the same time, they profit from the liberalization of the gas and electricity markets and from increasing energy demand in emerging economies. By combining these requirements, we identify four relevant investment clusters – as illustrated in the figure:

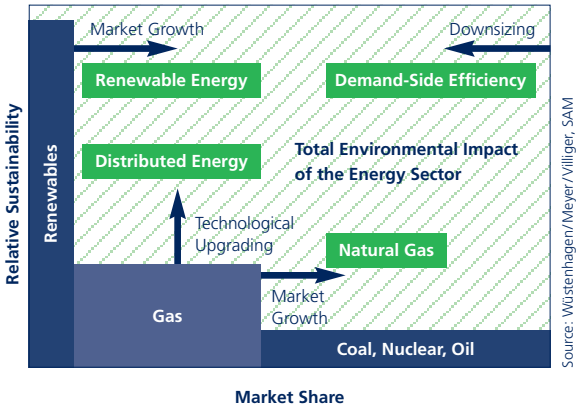
- **Renewable energy:** the growth of renewable energy sources causing the least environmental impact.
- **Distributed energy:** distributed energy systems reduce transportation losses and use natural gas more efficiently than is typical today thanks to combined heat and power generation.
- **Natural gas:** the growth of the market share of natural gas as a rapidly implemented and broadly effective way of reducing the carbon intensity of energy supply.
- **Demand-side efficiency:** the market for products and services that contribute to the more efficient use of energy by end-users and therefore reduce overall demand for energy and related environmental impacts.

Figure 12:
Identification of the four sustainability investment clusters

Figure 12



Source: SAM/CERA



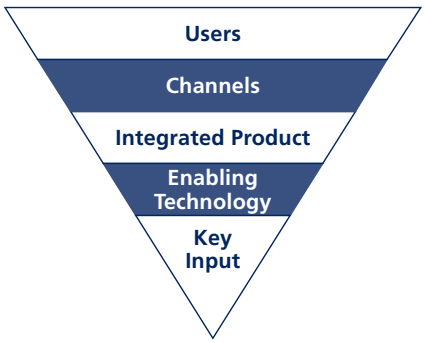
"Value chain" dimension

SAM believes that the key to successful investments in sustainable energy lies in focusing on these four clusters. Within each cluster we need to identify the segments with the greatest growth potential. In order to do this, we need to answer a number of questions such as:

- Which competing technologies and services are able to meet the same customer demands in this segment?
- Which complementary technologies and services will profit from any growth in this segment, and which enabling technologies in turn support them?
- What are the competitive advantages of the individual technologies and services? When will they reach market maturity?
- In which target markets are conditions particularly favourable for the rapid diffusion of technologies and services? How large is the market potential?
- Who are the players in these segments?

Figure 13:
Investment opportunities along the value chain

Figure 13



Source: CERA

An important element of the investment philosophy is the analysis of the entire **value chain,** as illustrated in the triangle above. This illustrates that promising investment opportunities can be found not only at the level of the core product (e.g. fuel cells), but often also at upstream and downstream stages of the value chain (e.g. hydrogen processing using reformers). Often, products and technologies that enable the success of a core product (enabling technologies, e.g. catalyst and membrane materials) and can be used in a wide range of applications, are particularly attractive. Therefore, an investment portfolio that is attractively structured from this perspective requires not only an in-depth knowledge of the core product and its players but also knowledge of a broad field of interrelationships between technologies and markets.

"Company diversification" dimension

The third dimension used to compose a portfolio is the **diversification of company-specific risks**. SAM takes this dimension into account by investing in three areas:

- **Leaders:** large, quoted companies with an attractive product portfolio and above-average sustainability performance.
- **Pioneers:** high-growth, quoted companies with a low to medium market capitalization that enable a quantum leap in a sector's sustainability by developing new sustainable products.
- **Private equity:** young, innovative companies that are not yet quoted on the stock market and stand out due to their high growth potential, at the same time involving relatively higher risks.

Investment potential of the sustainable energy clusters

"Growth rates in excess of 20 % per annum"

Investment cluster "renewable energy"

The efficient use of renewable energy sources offers considerable long-term market potential from a financial, environmental and social perspective. They have an advantage over fossil fuels in that they have significantly smaller negative effect on humankind and the environment. However, only 2.7 % of worldwide demand for energy is currently met using renewable energy sources, of which hydropower represents 90 %. The reason for this slow market diffusion is that many of the technologies have not yet or are only just reaching maturity and initial costs are relatively high. However, costs will continue to fall sharply in the coming years and competitiveness will grow as a result of increasing research and development efforts and achieving economies of scale as production volumes rise. As figure 14 shows, competitiveness is achieved earlier on in regions without an existing electricity grid. These are mainly regions in emerging economies in which electricity is currently produced using energy-inefficient diesel gensets.

Increasing competitiveness

In industrialized nations the cost of base load electricity generation in gas-fired and nuclear power plants is 3 to 6 cents/kWh. This shows that, in addition to hydropower, which has been cost-competitive for decades now, especially wind and geothermal energy have attractive future market potential. Furthermore, as production becomes increasingly distributed, electricity prices become more volatile and industrialized nations implement environmental and climate policies, market potential will continue to increase.

Wind energy

Wind energy has now reached a competitive level of pricing and produces electricity at 4 cents/kWh at favourable locations. After developing well over the last few years, the market for wind parks will continue to grow by 25 % on average each year (see table 1). The markets in India, China, Norway, North Africa and France will experience higher growth rates as will the market for offshore wind parks over the medium term.

In addition to wind turbine manufacturers such as Vestas, NEG Micon and Gamesa, investment opportunities also present themselves at the upstream and downstream stages of the value chain. Developers and operators of wind parks of the caliber of Plambeck Neue Energien and Denker & Wulf have made a significant contribution to the growth of Germany's wind energy market and are shortly to face the challenge of entering new markets such as France and Italy. At the same time, more and more established utilities companies are moving into the market, especially in the USA. There is still a great deal of innovative potential to be exploited by suppliers to the wind industry, e.g. new rotary blade materials and designs, the development of light, directly powered generators, and the servicing and grid integration of offshore wind parks.

Figure 14:
Increasing competitiveness of renewable energy

Figure 14

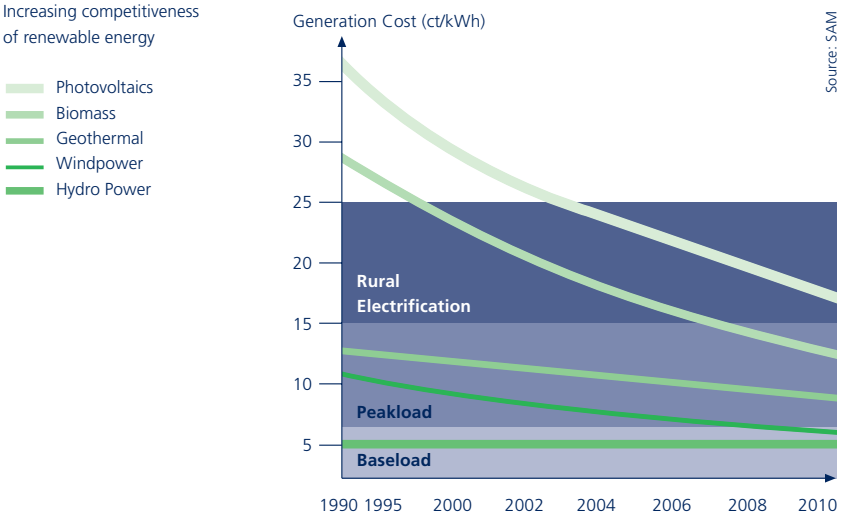


Table 1: Wind market development

Market	Installed Capacity 2001	Installed Capacity 2006E	Capacity Growth (MW)	Growth Rate (p.a.)
Germany	8 754	14 200	5 446	10.2 %
USA	4 260	18 000	13 740	33.4 %
Spain	3 337	7 000	3 663	16.0 %
Denmark	2 417	3 500	1 083	7.7 %
India	1 407	3 500	2 093	20.0 %
Italy	620	1 980	1 360	26.1 %
UK and Ireland	599	2 800	2 201	36.1 %
Netherlands	493	1 150	657	18.5 %
China	400	2 000	1 600	38.0 %
Sweden	290	1 460	1 170	38.2 %
Greece	272	1 200	928	34.6 %
Australia, New Zealand	140	1 150	1 010	52.4 %
Portugal	111	530	419	36.7 %
Rest of world	1 800	9 000	7 200	38.0 %
Total	**24 900**	**67 470**	**42 570**	**22.1 %**

Source: SAM, EWEA, AWEA

"Sharply falling production costs"

Photovoltaics

Photovoltaics, i.e. the direct use of sun light for electricity generation, is only competitive in niche markets today. However, there is also evidence of rapid development, leading to attractive prices as a result of sharply falling production costs. The currently small market achieves average growth rates of 25 to 30 % per annum. Around 40 % of the total capacity is sold to emerging economies. As a result of the lack of grid infrastructure and the consequently greater competitiveness of this technology, this percentage may rise further. Grid distributed applications represent the largest growth segment in OECD countries. This segment is profiting considerably from state incentive schemes in place in leading industrial nations, above all Japan and Germany. The Japanese government has approved a target of 4.8 gigawatt of installed PV capacity, corresponding to annual growth rates of 46 %.

Figure 15

Source: IEA

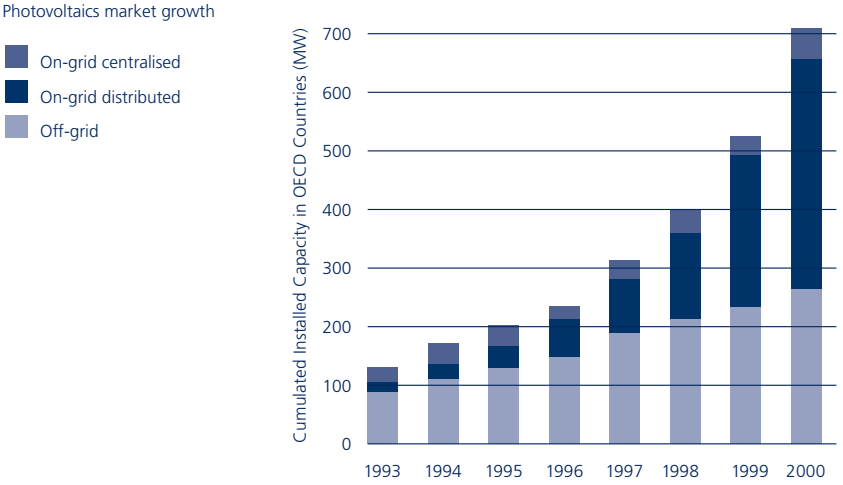


Figure 15:
Photovoltaics market growth

"Increasing demand for micro-grids and energy storage"

In addition to wind and photovoltaics, other sements of the renewable energy market such as geo-thermal energy, solar heat, new forms of hydropower and biomass use are also expected to show attractive growth rates. Many of these technologies are currently being developed by small, private companies and will only emerge from niche markets in the medium to long term. Therefore, selecting attractive companies currently requires detailed knowledge of the development of the market and strategies of the companies concerned.

Power electronics

Manufacturers of power electronics and electronic measurement and communications systems will profit as they provide complementary technologies for wind turbines and solar cells. Power electronics are required to process the electrical energy produced to monitor and manage network power quality, particularly in the case of distributed generation. Measurement and communications systems determine the quantity and quality of the electricity fed into the grid and communicate these data online to the network operators. Thus they reduce operational and administrative costs and increase the competitiveness of distributed energy systems.

Storage technologies

In off-grid applications, e.g. in remote rural areas in emerging economies that are to be newly electrified, demand increases for micro-grids and storage technologies. Energy can be stored using new battery technologies or hydrogen. Hydrogen has an advantage in that it can be used at the same time to treat drinking water, a major additional benefit in emerging economies.

Table 2: Renewable Energy

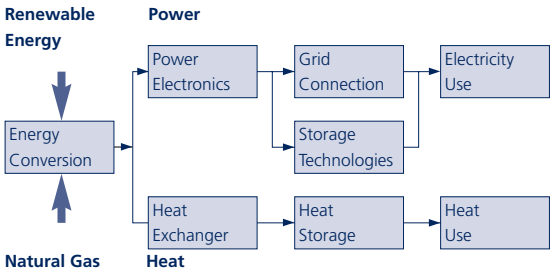
	Technologies	Target Markets	Market Size Today ($)	Growth p.a.	Players
Wind		– Onshore – Offshore	8.5 bn	20–25 %	Vestas, NEG Micon, Gamesa
Photovoltaics	– Crystalline – Thin film	– On-grid centralized – On-grid distributed	1.2 bn	25–30 %	BP, Shell, AstroPower, Evergreen Solar
Hydroelectric Power	– Pump storage – Run-of-river – Wave energy	– Distributed and Renewable energy	<11 bn	5–25 %	Österreichische Elektrizitätswirtschafts AG, Energetech Corp

Investment cluster "distributed energy"

Distributed energy systems allow the use of heat and electricity and thus increase energy efficiency from an average of 40 % to up to 80 %. Furthermore, they increase security of supply and eliminate high energy costs at peak load times.

Figure 16:
Distributed energy value chain

Figure 16



Source: SAM

Change of paradigm

Industrialized nations are driving the trend towards distributed energy systems as a result of advancing market liberalization and increasing demand for power quality and combined heat and power generation. Centralized power plants and distribution systems will make way for an extremely distributed structure over the longer term. In contrast, the development of distributed electricity production in emerging economies is a direct result of the electrification or extended electrification of regions with no or only some existing energy infrastructure. Although the driving forces in these cases are primarily different, many of the newly emerging technologies can serve both markets and profit accordingly from both developments. According to estimates from the US Department of Energy (DOE), distributed energy systems will secure a market share of 10 % to 20 % of new capacity by 2003. Industry estimates are somewhat higher at 20 % to 30 %.

"Greater energy efficiency through combined use of heat and power"

Markets

Within this market, applications differ in terms of their performance, the cost of electricity, their availability, their typical duration and the ratio of electricity to heat sold. Therefore, the segment ranges from small UPS systems (uninterruptible power systems) for IT infrastructure with an output of 1 kW to large systems for the combined use of heat and power in office complexes with 500 to 1,000 kW of output. We believe that systems for combined heat and power generation with an output of 5 to 500 kW and distributed energy systems in non-electrified regions of emerging economies represent the most attractive markets in terms of sustainability.

Technology fields

As a result of this paradigm change, various technology segments are experiencing significant growth. In addition to conversion technologies, power electronics, innovative storage systems and measurement and communications technology will profit.

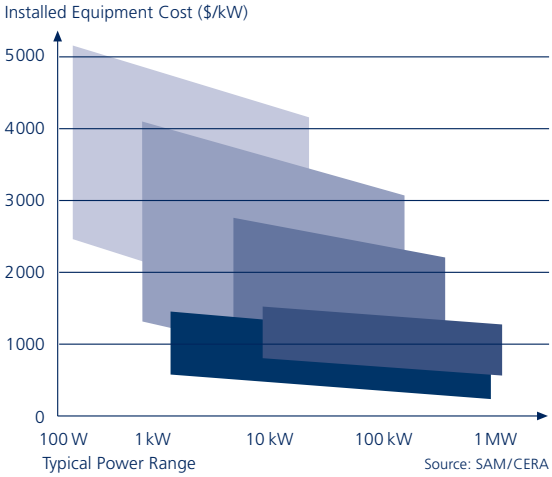
Conversion technology

In the energy conversion segment, natural gas-fired technologies such as fuel cells, Stirling engines and gas-fired combustion engines harbour interesting market potential in addition to the wind parks and photovoltaic power plants already mentioned. They produce low levels of CO_2 and NO_x emissions and profit from the gas distribution infrastructure already in place. While gas-fired combustion engines are more technologically mature, Stirling engines offer a higher degree of efficiency at lower emission levels. As is the case with fuel cells, the small number of moving parts spells a considerable reduction in maintenance costs. Over the longer term, fuel cells have the greatest cost-cutting potential, but not all technical problems have been solved to allow permanent practical application. Figure 17 shows typical output ranges and the range of specific installation

Figure 17:
Competitive landscape of distributed energy technologies

- Photovoltaics
- Fuel Cell System
- Microturbine
- Windconverter
- Natural Gas Engine

Figure 17



Source: SAM/CERA

costs. The points at which the output ranges overlap also indicate which products will in the future compete with one another.

Commercial viability and additional benefits

The price of the natural gas required and the price of electricity in the specific market have an important influence on the commercial viability and market diffusion of these systems. Low natural gas prices and rising electricity prices increase commercial viability and reduce the pay-back period. Current prices in the state of New York and California make micro turbines competitive. Factoring in the benefits of additional heat generation, lower emissions and greater security of supply increases commercial viability quite significantly.

Power electronics

As is the case with the use of renewable energy sources, power electronics process the energy generated to network specifications and feed it into the grid. Decisions are made using innovative metering and control systems and the relevant data is forwarded to the necessary players using communications applications.

This technology segment may experience significantly higher growth rates than the individual electricity and heat generation technologies as it is required in every system regardless of the energy conversion technology chosen.

Energy storage

Energy storage is another segment to grow hand in hand with distributed energy systems. In this instance, the technologies differ from one another in terms of their typical storage capacity and relevant areas of application. While flywheels and supercaps only offer a solution to short power cuts and are used mainly in the UPS and power quality segments, new innovative batteries and hydrogen storage systems offer sufficient capacity for distributed applications.

Larger storage systems based on hydrogen or pumped storage hydropower plants make it possible to store surplus electricity while demand is low and then to feed this into the network when demand rises or there is a possibility of supply bottlenecks. This reduces peak load production using fossil fuels.

Figure 18:
Gas and electricity prices determine commercial viability

Figure 18

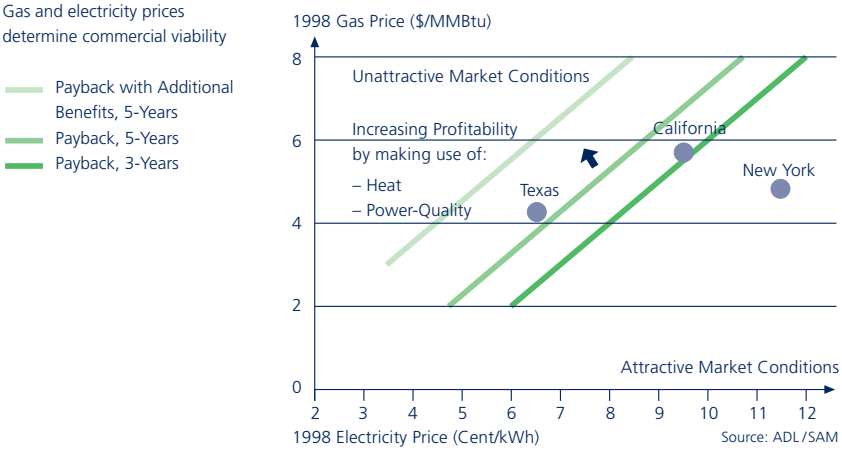
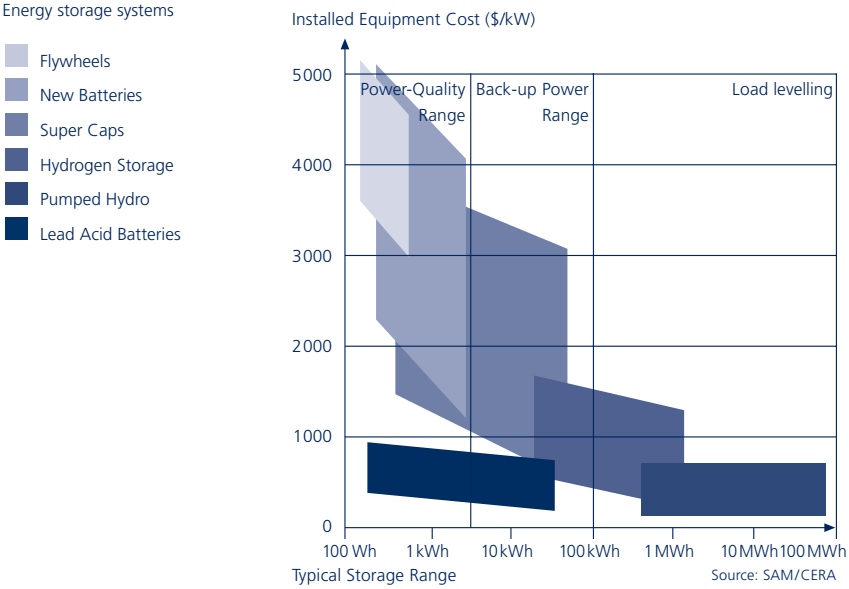


Figure 19:
Energy storage systems

Figure 19



Investment cluster "natural gas"

From the perspective of sustainability, natural gas is preferable to other fossil fuels due to its low carbon intensity. Substituting oil or coal with natural gas therefore reduces the risk of climate change. Natural gas currently covers 22 % of global primary energy supply. It is expected to grow at three times the growth rate of oil over the next two decades, translating into a 35 % increase in world-wide natural gas consumption by the year 2010. Replacing coal with gas in electricity supply can lead to a substantial reduction in CO_2. In the UK for example, the share of natural gas in the electricity generation mix rose

Table 3: Distributed Energy

	Technologies	Target Markets	Market Size Today ($)	Growth p.a.	Players
Combined Heat and Power Generation	– Fuel cells – Stirling engines – Microturbines – Gas engines	– Distributed energy – UPS	<1 bn	20–40 %	FuelCell Energy, Sulzer Hexis, Caterpillar, Capstone, General Electric
Energy Storage	– Flywheels – Batteries – Supercaps	– Distributed energy – UPS – Transport – Portable	10–20 bn	10–25 %	Active Power, Electrovaya, Electric Fuel, Evercel, Maxwell, Panasonic
Power Electronics	– Power semiconductors – System integrators	– Distributed and renewable energy – Transport – UPS	2–3 bn	20–40 %	Aixtron, Xantrex, Magnetek, Emerson, ABB, Satcon

from less than 1% to 33% between 1990 and 1999, leading to a reduction by a third of CO_2 emissions from this sector (figure 20). Therefore, natural gas can form a bridge between today's fossil-fuelled energy supply and a future renewable energy supply.

There are opportunities for investment in the natural gas market along the entire value chain. We identify four main fields: exploration and production (E&P), transportation, trading and the use of natural gas.

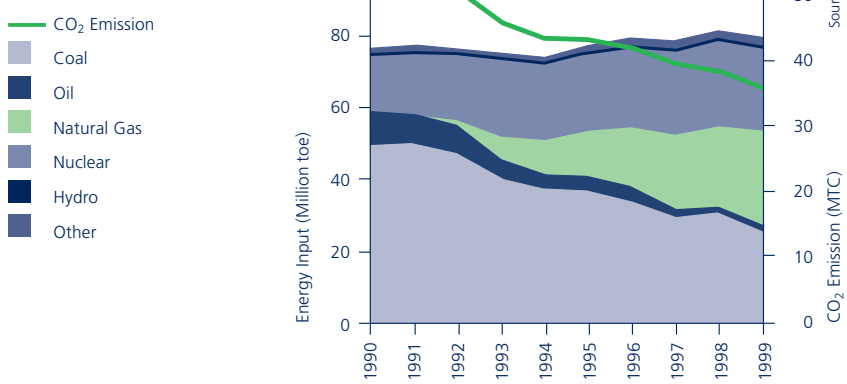
Exploration and production (E&P)

The E&P segment covers the discovery and production of natural gas and therefore forms an essential basis for predicted growth rates in the natural gas market. New and promising segments include specific technologies for exploration and production in deepwater areas (deepwater technologies) and offshore drilling technology, for example remote-controlled maintenance and installation robots. Furthermore, there is a need for new materials and measurement equipment that can cope with these increased demands. However, most players in these segments operate in both the gas and oil sector. Although this broad exposure increases their growth opportunities, it makes it difficult to prove added sustainability value.

The extraction of natural gas from the interfaces of deep coal deposits (Coal Bed Methane, CBM) offers a new area of interest for pure players in the natural gas sector. It does not involve extracting the coal. Instead, the methane from the coal that collects along the interface is used. This process is already being used in commercial applications by a number of North American companies such as Evergreen Resources, El Paso and Barett Resources.

Figure 20:
CO_2 reduction in the UK electricity industry due to natural gas

Figure 20



Transportation

Today, natural gas is transported primarily through pipelines. However, the growth of the gas market will bring with it corresponding growth of transportation infrastructure. If we examine supply and demand, we learn that the regions in North America and Europe with the highest demand are having to rely to an increasing extent on more remote deposits. While Europe's location is strategically favourable relative to the world's largest natural gas deposits in western Siberia, Iran, the Middle East, North Africa and the North Sea, the centres of consumption in the USA are further away from the relevant resources (figure 21). In these areas, non-pipe forms of gas transportation will become increasingly important. There are

essentially two options available: the transportation of liquefied natural gas by sea (Liquefied Natural Gas, LNG) and the production of synthetic fuels from natural gas (Gas-to-Liquids, GTL).

Liquefied Natural Gas, LNG

LNG is a 40 year-old technology based on the cooling of natural gas at the production site to –160°C, thereby reducing the volume by a factor of 600. After being transported in special LNG tankers, the gas is revaporized at its destination and fed into the normal gas network. In 1999, natural gas transported in this manner accounted for just 5% of global gas consumption. The main buyers are the resource-poor Asian countries of Japan, Korea and Taiwan, which meet practically all their natural gas requirements with LNG. In the USA, LNG currently has a market share of just 1% while, in contrast, 99% of the gas is either produced within the country or imported by pipeline. However, as a result of rapidly increasing consumer demand, the LNG market will expand rapidly to the extent that liquefaction capacities will rise by 50% by 2005 and by more than 100% by 2010. World-wide, the LNG market will grow from 15.8 BCF a day at present to 34.02 BCF in the year 2010. The driving factors are the market success of gas turbines in electricity production, falling costs in the LNG value chain, aspects of supply security and the possibility of start-up assistance for the development of a gas market in emerging economies. From the perspective of sustainability, it is important to note that grey energy expenditure for the liquefaction of natural gas is around 5% to 10% of primary energy. Energy efficiency can be increased if the cooling load released at the revaporization terminal is used for industrial processes. Within the LNG value chain, liquefaction technologies and the transportation segment offer attractive investment opportunities. The liquefaction process should now be viewed as a mature technology, where APCI and Phillips have a dominant position in the plant market. However, new rivals can be expected to enter the market. In the transportation segment we observe a trend away from vertically integrated companies such as Royal Dutch/Shell which dominate the entire transportation chain towards specialized manufacturers and operators of LNG tankers, a development that brings with it new investment opportunities.

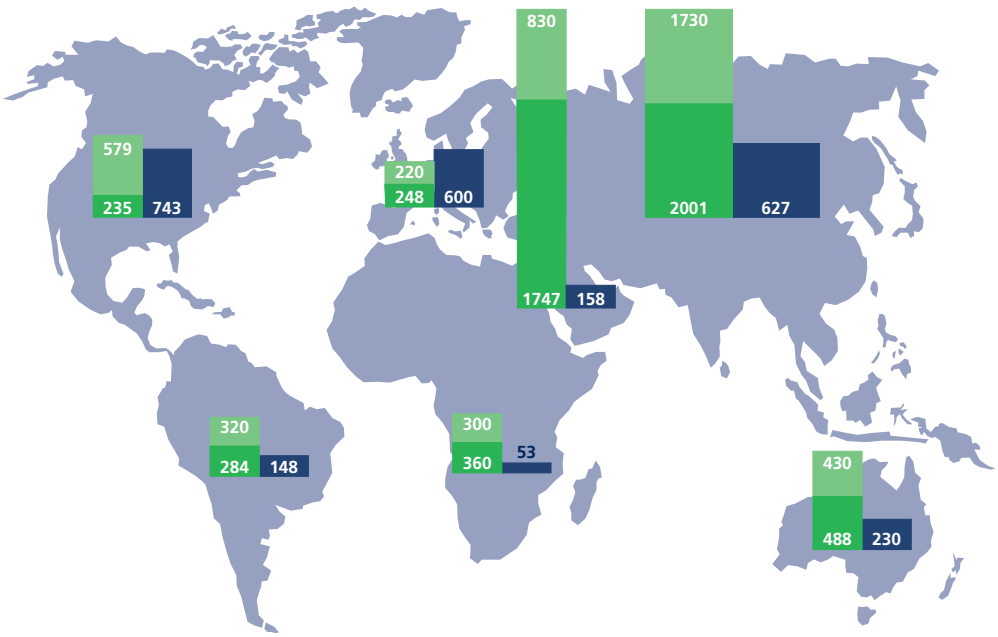
Gas-to-Liquids Technologies, GTL

The other possible use for stranded gas resources is the production of synthetic fuels using Gas-to-Liquids technology (GTL). Originally developed by the German chemists Fischer and Tropsch, the main area of application for GTL has been the oil-independent production of fuels. The energy intensity

Figure 21:
Regional supply and demand of natural gas

- Discovered Reserves in TCF (Trilion Cubic Feet)
- Undiscovered Reserves in TCF
- Projected Consumption (1996 consumption level for 30 years)

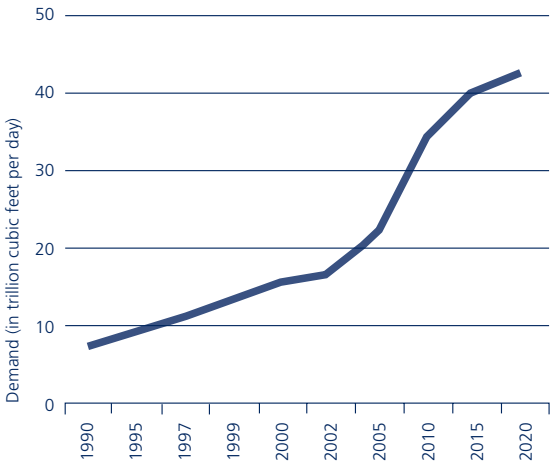
Figure 21



Source: ADL

Figure 22:
Global LNG demand growth

Figure 22 Source: CERA



"Integrated electricity and gas producers as the beneficiaries of the liberalization and convergence of electricity and gas markets"

of the original Fischer-Tropsch process was very high. However, as a result of technological innovations, GTL can be used much more energy-efficiently, albeit not as efficiently as LNG. Therefore, GTL may have growth potential mainly in niche markets, for instance for the production of low-sulphur fuels that profit from strict clean-air purity regulation.

Trading platforms

In addition to newly emerging transportation technologies, the trading of natural gas takes place within a rapidly changing environment. The driving forces are the liberalization of gas and electricity markets and increasing demand for natural gas for electricity generation, which leads to the convergence of the two markets. In the longer term, this may result in a stronger correlation between electricity and gas prices while the correlation between gas and oil prices is reduced. There are indications of such a development in California, for instance, where peaking electricity prices were accompanied by a sharp rise in gas prices in recent months. This trend is encouraged by the growing number of marketplaces for trading in derivatives and short-term contracts for natural gas which allow industrial bulk buyers and electricity producers to hedge against price risks resulting from increasing price volatility and to use more natural gas.

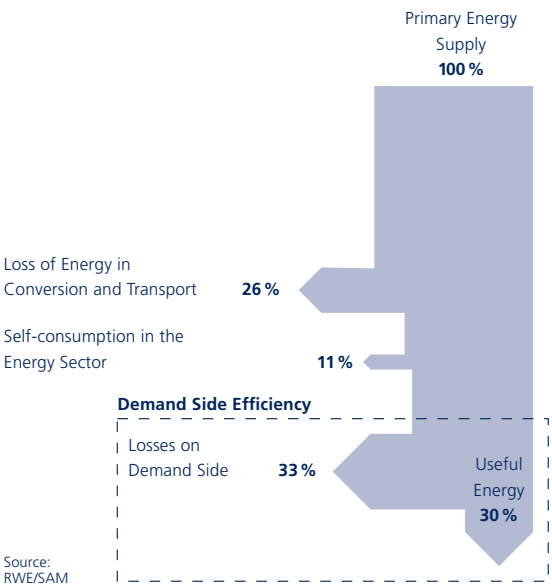
In order to secure price transparency and a liquid and arbitrage-free market, real-time information on supply, demand and other important influencing parameters has to be available at low transaction costs. This in turn opens up new markets for enabling technologies used precisely to generate and make accessible this information and facilitate trading on an efficient market platform. In the medium term, cost-effective technologies for the measurement of natural gas consumption and real-time communication of these data in particular could represent attractive markets. As part of the same trend, the balancing of peak load energy in both the electricity and gas market will increase demand for intelligent systems at the user end that, at the same time, receive and process price information and optimize consumption at peak load times.

Natural gas at the user end

In the context of natural gas usage, producers of electricity and heat enjoy a number of attractive competitive advantages thanks to the benefits of natural gas mentioned above. State-of-the-art gas-fired power plants in particular are ideal for covering peak demand and thus offer established utilities an attractive addition to their portfolios of electricity and heat production facilities. Over the past couple of years a number of new suppliers (Independent Power Producers) with strategies geared almost exclusively to natural gas have gained a relatively sig-

Figure 23:
Greatest potential found in demand-side efficiency

Figure 23



nificant market share. Their long-term success depends, however, largely on how demand for electricity develops. Fierce competition has also flared up on Europe's gas market, as evidenced by the numerous acquisitions and mergers (including RWE and UK-based Innogy, Lattice Group and National Grid and the battle for Germany's Ruhrgas).

Efficient conversion plant, which is also profiting from the natural gas boom, represents another attractive segment at the user end of the natural gas sector. This ranges from combined cycle power plants operating in the megawatt range to small fuel cell systems used to produce electricity and heat in a detached family home. Here, there is some overlapping with the distributed energy and demand-side efficiency clusters.

Investment cluster "demand-side efficiency"

The Sustainability Roadmap shows the efficient use of energy at the user end to be a fourth sustainable energy strategy. Thus it becomes possible to avoid energy costs and environmental and social impacts associated with any kind of energy provision. Therefore, this level represents the last stage of the journey from primary energy, conversion and transportation to useful energy and is responsible for more than half of the losses that occur; on average 33 % of the primary energy is lost at this level. Avoiding such inefficiency would result in savings of around $187 billion a year in the USA alone. This shows the magnitude of the market potential for providers of energy-efficient technologies and services at this level. But where exactly do the largest losses occur, and where is the greatest potential to reduce these losses cost-efficiently?

Potential of demand segments

An analysis of the typical user segments (mobility, households, commercial and industry) and primary product segments, illustrated in table 5, reveals where the greatest potential to increase energy efficiency lies – in segments which account for a high proportion of energy consumption and, at the same time, harbour immense potential for energy savings. These segments are interesting as they are relatively strongly influenced by the key trends.

Figure 24 and table 5 show quite clearly that space heating and mobility harbour the greatest market potential. The two segments have a technical efficiency potential of more than 50 % and, at the same time, account for a large proportion of total energy consumption.

Facility Management

It is possible to satisfy the demand for space heating more efficiently by choosing new heating systems, better thermal insulation or a better energy management system. Distributed systems for small-scale combined heat and power generation can increase the energy efficiency of a building by a factor of two. Interesting new products include technologies such as micro turbines and fuel cell

Figure 24:
Energy efficiency in different end-use segments

Used Energy
Losses

Figure 24 Source: SAM/RWE

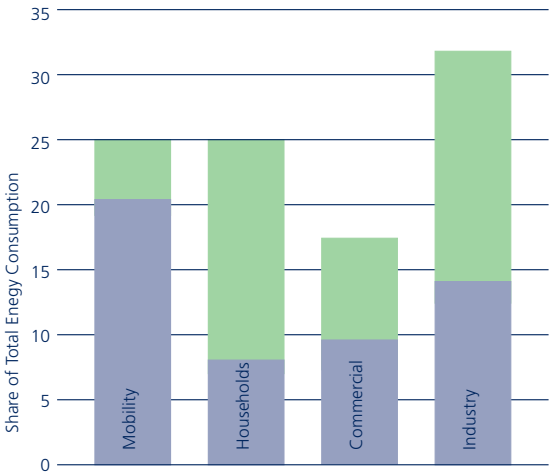


Table 4: Natural Gas

	Technologies	Target Markets	Market Size Today ($)	Growth p.a.	Players
Gas Production, Transport and Trading	– LNG – GTL	– USA/Canada, Europe, Japan	<100 bn	4–10%	BG Group, El Paso, Enbridge, Ruhrgas
Electricity and Heat Production/Trading	– CCGT – Gas engines – Fuel cells	– USA/Canada, Europe, Japan	<100 bn	4–10%	RWE AG, Powergen Plc, Tokyo Electric & Power

Tabelle 5:
Market size and efficiency potentials

„Hybrid Electric Vehicles become more attractive“

Table 5: Market Size and Efficiency Potentials

Demand/Product Segment	Share of Total Energy Use	Technical Efficiency Potential
Space heating in existing buildings	very large	70 to 90%
Space heating in new buildings	very large	70 to 80%
Hot water preparation	medium	10 to 50%
Refrigerators	small	50 to 60%
Washing machines	small	30 to 40%
Cars	very large	50 to 60%
Buses, trucks	small	15 to 25%
Processes basic materials industry	large	10 to 20%
Processes manufacturing industry	large	15 to 30%
Processes consumer goods industry	large	15 to 40%
Processes food industry	medium	10 to 30%

systems – as mentioned above in the context of distributed energy systems – as well as products using solar heat.

As an alternative to the increased efficiency of energy systems, the consumption of heat in buildings can also be reduced further with better thermal insulation using new innovative materials or with intelligent energy management systems.

Energy contracting companies employ this strategy. They supply under contract electricity and heat for the building at an agreed price and therefore endeavour to keep their own costs low by making efficient energy savings. More than 100,000 buildings in Germany are now served by contracting partners. However, this number represents just 7% of suitable properties. It can be expected to rise by 150% to 250,000 properties by 2004. In theory, the potential of suitable contracting projects in Germany is estimated to be 1.2 million properties, corresponding to an investment volume of up to 90 bn. EURO.

Mobility

Within this segment of demand, 86% of energy is spent on road vehicles. Of this, just under 80% is consumed by automobiles, vans and all-terrain vehicles. They are responsible for 76% of all carbon monoxide emissions and around half of all nitrogen oxide emissions world-wide. Pressure to reduce these emissions continues to increase sharply. In the USA for instance, the states of California, New York and Massachusetts have passed a law prescribing a defined sales quota of zero-emission vehicles from 2004 onwards. The automotive industry's response to these trends is a growing range of electric, hybrid and fuel cell vehicles. Manufacturers of the necessary enabling technologies will also profit greatly. Regardless of which technology is used and will succeed in the competitive market in the longer term, power electronics will be required in every vehicle. Revenues in this market segment could rise by 40% per annum over the longer term.

Other attractive technologies include new battery technologies, reformer technologies that processes the fuel and supercapacitors.

Table 6: Demand-Side Efficiency

	Technologies	Target Markets	Market Size Today ($)	Growth p.a.	Players
Facility-Management	– Contracting – Heating systems – New materials, Insulation – Energy management systems – Measurement and Communication systems – Smart cards	– Industry – Households		20–25%	Honeywell, Techem, Siemens, Silicon Energy
Mobility	– Hybrid electric drive – Supercapacitors – Reformers – Power electronics	– Vehicle manufacturers	<1 bn	30–40%	Honda, Impco, Enova, Toyota, DaimlerChrysler

Investment areas within the sustainability clusters

		Technologies	Target Markets	Market Size Today ($)	Growth p.a.	Players
Renewable Energy	**Wind**		– Onshore – Offshore	8.5 bn	20–25 %	Vestas, NEG Micon, Gamesa
	Photovoltaics	– Crystalline – Thin film	– On-grid centralized – On-grid distributed	1.2 bn	25–30 %	BP, Shell, AstroPower, Evergreen Solar
	Hydroelectric Power	– Pump storage – Run-of-river – Wave energy	– Distributed and Renewable energy	<11 bn	5–25 %	Österreichische Elektrizitätswirtschafts AG, Energetech Corp
Distributed Energy	**Combined Heat and Power Generation**	– Fuel cells – Stirling engines – Microturbines – Gas engines	– Distributed energy – UPS	<1 bn	20–40 %	FuelCell Energy, Sulzer Hexis, Caterpillar, Capstone, General Electric
	Energy Storage	– Flywheels – Batteries – Supercaps	– Distributed energy – UPS – Transport – Portable	10–20 bn	10–25 %	Active Power, Electrovaya, Electric Fuel, Evercel, Maxwell, Panasonic
	Power Electronics	– Power semiconductors – System integrators	– Distributed and renewable energy – Transport – UPS	2–3 bn	20–40 %	Aixtron, Xantrex, Magnetek, Emerson, ABB, Satcon
Natural Gas	**Gas Production, Transport and Trading**	– LNG – GTL	– USA/Canada, Europe, Japan	<100 bn	4–10 %	BG Group, El Paso, Enbridge, Ruhrgas
	Electricity and Heat Production/Trading	– CCGT – Gas engines – Fuel cells	– USA/Canada, Europe, Japan	<100 bn	4–10 %	RWE AG, Powergen Plc, Tokyo Electric & Power
Demand-Side Efficiency	**Facility Management**	– Contracting – Heating systems – New materials, Insulation – Energy management Systems – Measurement and communication systems – Smart cards	– Industry – Households		20–25 %	Honeywell, Techem, Siemens, Silicon Energy
	Mobility	– Hybrid electric drive – Supercapacitors – Reformers – Power electronics	– Vehicle manufacturers	<1 bn	30–40 %	Honda, Impco, Enova, Toyota, DaimlerChrysler

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SAM Sustainable Asset Management

SAM Sustainable Asset Management (SAM) was founded in 1995 as an independent asset management company specializing in sustainability investments. SAM is now one of the world's leading asset managers in its field, working with banks, insurance companies, pension funds, and trusts and foundations in addition to private investors. SAM analyzes companies systematically to identify sustainable success criteria. The integration of these forward-looking criteria in the investment process gives investors a high degree of control and transparency, and ensures an attractive performance.

Alongside individual mandates for institutional clients, SAM offers financial products specializing in future-oriented energy technologies, sustainable food production, water, resource-efficiency, sustainability pioneers (companies that set the pace in pioneering technologies), sustainability leaders (companies at the forefront of their industry), and private equity.

SAM's know-how is drawn from its own research as well as the resources of an active worldwide sustainability network. Together with Dow Jones and STOXX, SAM has launched the world's first family of sustainability indexes which track the financial performance of companies that lead their industry in terms of sustainability. To this end, SAM evaluates more than 1000 companies every year.

SAM is headquartered in Zollikon-Zurich (Switzerland), and has branch offices in Chicago (USA), Melbourne (Australia) and Milan (Italy).

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