

Industrial Products
Chemicals

Chemicals

Sector climate change responses



Background

Many chemicals sector companies are already taking pro-active steps to reduce emissions and energy consumption. Improving technical processes in chemicals production and enhancing the use of renewable raw materials are two common strategies. Many are also targeting their physical plant; installing more efficient heating and cooling systems, for example. At least one company is going an additional step further and adding solar panels to plants. And while industrial processes account for the bulk of the industry's carbon footprint, many are also encouraging employees to look for energy saving potential both in the workplace, at home and during their commute.

While many chemical manufacturers are aggressively targeting their own carbon footprint, the majority also stress the role they can play to fight climate change through researching and developing product offerings which help customers reduce their carbon footprint. As one example, chemical products play a key role in reducing the carbon footprint of buildings, through the use of insulation and other applications. Life Cycle Analysis (LCA) looks at the emissions generated during the entire life cycle of a product, from extraction to manufacture, transportation, usage and finally recycling or disposal at the end of a product's useful life. LCA is becoming an increasingly popular tool to demonstrate the positive impact such products can make on the carbon footprint of customers. The global chemical industry's umbrella trade organization, the International Council of Chemical Associations (ICCA), has published a much-quoted study which estimates that when their whole lifecycle is considered, the industry's products save 2.1-2.6 times as much carbon as was emitted in their initial production and disposal.¹ While there are some debates about the specific figures cited in the ICCA report, major players in the industry are also doing their own research in this area. A number of the manufacturers we reviewed already include LCA calculations within their design process and are actively promoting products with 'Eco' credentials. Some have already set goals for reducing carbon at the customer level, or for ensuring

that a certain percentage of their own revenues stem from environmentally-friendly products.

The ICCA's report also recommends that policymakers acknowledge the role the sector can play as a catalyst in combating climate change. The trade organisation advocates for a global carbon framework to accelerate greenhouse gas (GHG) emissions reductions to avoid market distortions and minimise carbon leakage. Carbon leakage can occur when production or investment shifts to countries not subject to regulation, or when companies based in regulated countries (such as those in the EU) lose market share to competitors operating in regions without emissions regulation. Some of these shifts might mean moving production from a facility with lower GHG emissions to a less-efficient facility with higher emissions – creating a net loss in the battle against climate change. In Europe, where some chemical companies are subject to the EU Emissions Trading System (EU-ETS), the European Chemical Industry Council (CEFIC) has been openly critical, charging that since its implementation in 2005, the system has shown significant weaknesses. CEFIC cautions that an increase in auctioning of allowances in the next phase of the scheme would disadvantage European chemical producers in global competition.

Certainly, the chemical sector has already made considerable progress towards improving energy efficiency. In the EU, CEFIC reports that the sector's energy use per unit of product has been substantially reduced (in 2005 by 42% as compared to 1990). Across the Atlantic, member companies of the American Chemistry Council (ACC) reduced absolute GHG emissions 16% between 1990 and 2008, exceeding Kyoto Protocol requirements. The ACC reports that these companies' greenhouse gas intensity – a measure of emissions per unit of output – fell (improved) 39.4% in the same time period. Brazilian chemical association members reduced specific overall energy consumption between 2001 and 2007 by 25% while increasing overall production by almost 30%. Given the volatile cost of

¹ ICCA, "Innovations for Greenhouse Gas Reductions: A life cycle quantification of carbon abatement solutions enabled by the chemical industry," 2009.

energy produced from fossil fuels, most companies argue that improving their energy efficiency and increasing the use of renewable energy sources is good business, as well as good for the environment.

As already noted, though, while sector companies are committed to reducing their own carbon footprint, the contributions their products and research can make to improve the energy and emissions profile of their customers may have a more far-reaching impact. Sector contributions range from improving the carbon footprint of the built environment – commercial buildings, housing, factories, etc. – to facilitating diverse forms of renewable energy, from helping automakers reduce the weight of vehicles, to contributing to improved process efficiency in manufacturing sectors. In some cases chemical companies are even using CO₂ as a feedstock, rather than emitting it to the atmosphere.

The built environment accounts for a significant amount of overall GHG emissions; in some countries, energy usage

in buildings accounts for nearly 50% of total emissions. In this area, though, significant improvements can be gained using current technology. Better insulation can make a substantial difference in the amount of energy needed for heating and cooling – indeed, the ICCA singles out insulation as the industry product with the greatest net benefit during its life cycle – and sector products such as polyurethane are leading the way. The industry has not stopped there, though. Some sector companies are innovating further, with developments like shades that reflect away heat, but allow in natural daylight, or highly reflective interior paints that reduce the need for artificial lighting. New innovations in light-emitting diode (LED) and organic LED (OLED) technologies are also paving the way for significantly more efficient artificial lighting when needed.

Transport is another significant source of GHG emissions, and another area where sector products are making a difference. Technological advances in lightweight, yet durable plastics and other composite materials

Focus on energy efficiency: areas where chemical companies are actively contributing

Company	Insulation Materials	Other Building Solutions	Lighting	Industrial process improvement	Construction materials	Automotive solutions
AkzoNobel NV		√	√	√	√	
BASF SE	√	√	√	√	√	√
Bayer AG	√	√		√		
E. I. du Pont de Nemours and Company		√	√	√	√	√
Evonik Industries AG	√	√		√		
LyondellBasell Industries				√		
Mitsubishi Chemical Holdings Corporation			√			√
The Dow Chemical Company	√	√		√		

√ Products/solutions either commercially available or currently under development.

Sources: Company annual reports and sustainability/corporate responsibility reports, company websites, PricewaterhouseCoopers analysis.

means that they are suitable for increasingly broad applications within passenger and commercial vehicles and aircraft. The reduction in weight translates into improved fuel efficiency, as well as fewer GHGs emitted into the atmosphere. Even the roads on which vehicles drive are becoming greener, thanks to research and development (R&D) within the chemicals sector. One company has developed a new asphalt binder which not only improves the durability of road pavings, but also enables the transportation and laying of asphalt at lower temperatures, resulting in significant energy savings.

Improving the efficiency of industrial processes can help achieve real energy savings, both within the chemicals sector and in other industries. Once again, cutting edge R&D by the chemicals sector is helping to lead the way. Some technologies are still under development; for example, one company is researching oxygen depolarized cathode (odc) technology based on common salt – future use of odc technology for industrial-scale chlorine manufacture is expected to reduce energy requirements from 30-50%. Other solutions are already available,

such as implementing an Ethylene Dryer, or treating nitrous oxide emissions with a new catalyst that helps them decompose. In at least one case, competitors have joined together to develop new, more efficient solutions. Both The Dow Chemical Company and BASF received a 2010 Presidential Green Chemistry Challenge Award for their jointly developed hydrogen peroxide to propylene oxide (HPPO) technology. This technology enables the companies to produce propylene oxide with less wastewater and energy use.

A number of sector companies are also exploring potential uses of carbon capture; one technique aims to use captured CO₂ as a feedstock for chemical production (for example, polyether polyols), while another is looking to use algae to produce ethanol in a bio-refinery.

Bio-fuels are not the only type of renewable energy source where chemical producers are driving advancements. Industry players are also working together with other industrial partners to develop fuel cell technologies, as well as the advanced lithium-ion

Focus on renewable energy: areas where chemical companies are actively contributing

Company	Solar	Wind	Carbon Capture	Fuel Cells / Lithium Ion Batteries	Other Renewable Energy
AkzoNobel NV					
BASF SE	√	√	√	√	√
Bayer AG			√		√
E. I. du Pont de Nemours and Company	√	√			√
Evonik Industries AG	√		√	√	
LyondellBasell Industries					
Mitsubishi Chemical Holdings Corporation	√			√	
The Dow Chemical Company	√		√	√	

√ Products/solutions either commercially available or currently under development.

Sources: Company annual reports and sustainability/corporate responsibility reports, company websites, PricewaterhouseCoopers analysis.

batteries necessary for both fuel cell powered vehicles and electric or hybrid vehicles. The industry is also heavily involved in advancing the solar industry, from improving the production of building block chemicals to development of advanced photovoltaic applications of all sorts, from thin films to 'solar shingles' for residential housing. The industry is also helping provide new, advanced coatings and materials for wind turbines, and researching next generation solutions.

While not every company in the sector is addressing the challenges posed by climate change, the industry does include a number of pro-active companies doing their part to drive change. Many chemicals companies are making major efforts to ensure transparency around their own GHG emissions, their efforts to reduce them, targets for the future, and the ways in which they contribute to the emissions profiles of their customers. The Global Reporting Initiative (GRI) third generation

(G3) set of standards is used by many in their reporting; some also reference the World Resources Institute / World Business Council for Sustainable Development (WRI/WBCSD) Greenhouse Gas Protocol. Some of the key indices around sustainability and climate change are recognising the sector's efforts. Indeed, two European sector companies (Bayer and BASF) received the highest and second highest rankings in the Carbon Disclosure Project's Carbon Disclosure Leadership Index.

Based on our review of the activities of major chemical companies around the globe, we found a number of chemical companies are taking climate change seriously. Some are transforming not only their own business, but also those of their customers. Continuing to find ways to improve their own carbon footprint, and provide tools for their customers to reduce their GHG emissions will be critical to their future success.

Featured chemical companies' inclusion in external sustainability indices/programmes

Company	Listed on a Dow Jones Sustainability Index	Carbon Disclosure Project Leadership Index Score	Pew Center for Global Climate Change Business Environmental Leadership Council (BELC) Member	UN Caring for Climate Signatory
Akzo Nobel NV	√	62		√
BASF SE	√	94	√	
Bayer AG	√	95		√
E. I. du Pont de Nemours and Company	√	80	√	√
Evonik Industries AG		NA		
LyondellBasell Industries		NA		
Mitsubishi Chemical Holdings Corporation	√	AQ		√
The Dow Chemical Company	√	63	√	

Sources: PwC/SAM sustainability investing, The Sustainability Yearbook 2010; Carbon Disclosure Project, CDP 2009 Industry Snapshots – Global 500/S&P 500/FTSE 350; Carbon Disclosure Project, CDP 2009 Europe 300; Carbon Disclosure Project Website (www.cdproject.net); Pew Center for Global Climate Change website (http://www.pewclimate.org/companies_leading_the_way_belc/company_profiles); UN Global Compact website (http://www.unglobalcompact.org/Issues/Environment/Climate_Change/list_of_signatories.html)

Note: NA indicates that a CDLI score is not available as the company was not included in the CDP Information Request. AQ indicates the company received a CDP Information Request, but has not received a CLDI score.

The background of the entire page is a photograph of two workers on a metal walkway. One worker is wearing an orange protective suit and a white hard hat, while the other is wearing a blue protective suit and a white hard hat. They are shaking hands. The walkway has yellow railings and is set against a clear blue sky. The right side of the image shows a large, curved metal structure, possibly part of a tank or vessel.

Featured Company Highlights

Note on methodology: We reviewed information publicly available on company websites in May/June 2010, including annual reports and sustainability reports, for the top 10 chemical companies listed in the Global Fortune 500, in order to provide a brief overview of what actions the sector is taking. Companies are featured where extensive information was available. The information in this report represents a snapshot of activities and approaches to addressing climate change; it does not provide a comprehensive list of every measure currently being undertaken, nor does it provide assurance of the accuracy of the data published by individual companies.

Featured Company: AkzoNobel NV

Key achievements and targets: Beginning in 2009, measuring CO₂ emissions from 'cradle to gate' (that is, using a partial product life cycle analysis from manufacture ('cradle') to the factory gate i.e., before it is transported to the consumer).

Board of Management approved AkzoNobel Carbon Policy in early 2009. Improvement targets and ambition levels include:

- Reduce cradle-to-gate (Scope 1, 2 and 3 upstream) carbon footprint per tonne of product by 10% by 2015 (2009 baseline)
- Reduce cradle-to-gate carbon footprint per tonne of product between 20 and 25% by 2020 (2009 baseline)
- Control absolute Scope 1 and 2 greenhouse gas emissions below 2008 levels

Objective to increase eco-premium solutions to 30% of sales, reducing downstream footprint.

Research directions: Enhancing use of renewable raw materials. Cradle-to-cradle concept, with a goal to design and produce chemicals or coatings that can be readily recovered as raw materials once a product's useful life has ended.

Innovative use of new technologies: Advanced 'Lumitec' technology for interior paints, which enhances reflectivity, reducing the need for artificial interior lighting.

Collaboration with government, trade associations, etc. Diverse, examples include:

- Working with the WRI and the WBCSD piloting new tools to measure environmental impacts and opportunities for improvement.
- Involved with Eco-system Valuation Initiative started in 2008 and have taken part in developing the GHG Protocol Accounting and Reporting Guidelines for product lifecycles and corporate value chains (Scope 3); will road test the drafts in 2010.
- Signer of the UN Global Compact and an active member of the network in the Netherlands.

- CEO, Hans Wijers, asked to join the CNBC Carbon Council in November 2009.

Green product offerings: In 2009, achieved 20% of revenue from eco-premium solutions (2008: 18%)
Examples include:

- Dulux Ecosure Matt Light & Space range of decorative paints, which won the UK Green Business Awards Green Product Award for 2009. Dulux Light & Space energy saving highly reflective paint.
- Rediset WMX, a new asphalt binder which not only improves the durability of road pavings, but also enables the transportation and laying of asphalt at lower temperatures, resulting in significant energy savings and greatly reduced noxious fume generation.

Reporting: Uses GRI guidelines. In 2009, energy and GHG emissions reporting was updated to more fully align with the Greenhouse Gas Protocol, so 2008 and 2009 figures are not directly comparable. Sustainability reporting integrated into overall annual report; third party assurance statement published. Also see Collaboration with government, trade associations, etc.

“Our sustainability agenda gathered momentum during 2009. I took great pride in the fact that AkzoNobel was again listed among the world leaders in the Chemicals sector on the Dow Jones Sustainability Index, with a second place rating. Our clear objective is to remain in the top three.”

Hans Wijers
CEO and Chairman of the Board of Management
AkzoNobel

Featured Company: BASF

Key achievements and targets: Published a corporate carbon footprint in 2008, updated in October 2009. Calculates CO₂ emissions-savings achieved with products and procedures with the emissions from raw material extraction, production and product disposal. The company estimates that their products can save three times more greenhouse gas emissions than the entire amount created by their production and disposal.

From 1990 to 2002, reduced GHG by 38% in absolute terms and by as much as 61% in specific terms. Achieved global environmental goals for 2012 ahead of schedule in 2007.

In 2008, set climate protection targets for 2020:

- Reduce emissions of GHG per metric tonne of sales product by 25% (2002 baseline)
- Improve specific energy efficiency of production processes 25% (2002 baseline).

Has appointed a company-wide 'Climate Protection Officer', a C-suite level executive tasked with coordinating all of the company's activities around climate change.

Research directions: Around 400 million Euros, or one-third of the total research and development budget, is earmarked for the areas of energy efficiency, climate protection, resource conservation and renewable raw materials. Research areas include organic solar cells, and lithium ion batteries. Many partnerships with government, academia and other corporate partners. Other examples include:

- New Joint Innovation Lab — Organic Electronics opened in 2006, with cooperation partners from industrial companies, universities and research institutes. Primary activities are developing and enhancing active organic materials for OLEDs (organic light emitting diodes), a new type of lighting technology that may consume less than half as much electricity as conventional energy-saving lamps, and development of solar cells based on organic semi conductive materials (organic photovoltaics).
- Working together with Energie Baden-Württemberg AG (EnBW), Heidelberg University and Karlsruhe Institute of Technology (KIT) on a process to convert CO₂ into a fuel for fuel cells or retrofitted internal combustion engines.
- BASF and RTI International are jointly developing a new technology to capture carbon dioxide emitted by coal-fired plants.

Innovative use of new technologies: BASF catalyst for decomposing nitrous oxide emissions used in a nitric acid plant in Poland in a JI project, achieving reductions of nitrous oxide emissions by 1,1 million metric tonnes of CO₂ equivalents per year since 2009. Use of a similar process at AB Achema in Lithuania reduced nitrous oxide emissions by 700.000 metric tonnes of CO₂ equivalents in 2009.

Collaboration with government, trade associations, etc.: Initiates Clean Development Mechanism (CDM) and Joint Implementation (JI) projects for customers as well as for the company's own production sites. Member of the Business Environmental Leadership Council of the Pew Center on Global Climate Change since 2008. Member of

the World Bank's Community Development Carbon Fund (CDCF) since 2002.

Green product offerings: Offers a complete greenhouse gas project service to support customers from the application process through to the issuance of greenhouse gas certificates.

Neopor® – energy-efficient façade insulation;
Basotect® – heat insulating foam for solar energy systems; polyurethane (PU) rigid foams for cold as well as heat insulation applications. Lightweight plastics for use in automotive construction such as foam Neopolen® and a newly developed special grade of the engineering plastic Ultramid®. Epoxy resins and protective coatings for wind turbines.

Agrichemicals; Completed an Eco-Efficiency Analysis for corn. Both corn production with and without herbicide have been analysed. The results show that the use of the herbicide reduces costs, energy use and resources while improving yields.

Reporting: Report uses GRI guidelines and an index is provided; participates in GRI feedback meetings.

Renewable energy: Researching energies of the future. Several existing products contribute to the development of renewable energy, for example in catalysis and electro-chemistry for fuel cells, and in wind turbine applications.

“A business cannot be successful in the long term if it does not act responsibly toward the environment and society. That is why sustainability is an integral part of our strategy.”

Dr. Jürgen Hambrecht
Chairman of the Board of Executive Directors

BASF

Featured Company: Bayer

Key achievements and targets: Includes a climate programme as one of three key focuses of the company's sustainability programme. Target of €1 billion in investments in climate-related research, development and products from 2008 to 2010.

Goals for 2020, per business unit (2005 baseline)

- Bayer MaterialScience: Reduce GHG emissions by 25% per metric tonne of sales product (excl. NaOH, HCl, trade products)
- Bayer HealthCare: Achieve a 5% absolute reduction of GHG emissions
- Bayer CropScience: Achieve a 15% absolute reduction of GHG emissions

Bayer Technology Services has developed a new type of control tool (Bayer Climate Check) which is aimed at energy-efficient and climate-friendly production. By mid-2010, around 140 production facilities and buildings will have been examined. Based on calculations for 126 plants, Bayer believes there is realistic potential for reducing both energy consumption and GHG emissions by approximately 10% through 2013.

'Green it' initiative from Bayer Business Services focusing on energy-saving potential in IT and communication technology, with a goal to improve the energy efficiency of Bayer data centers in 3 locations by 20% between 2009 and 2012. Efforts are being supplemented by projects for cutting energy consumption and conserving resources at PC workstations and with centralised printers. Also setting up telepresence rooms and optimised video conferencing systems to reduce travel.

Reconfiguring the company's vehicle fleet, aiming to cut corresponding CO₂ emissions by 20% through 2012 compared to 2007 levels.

Research directions: Dream production: pilot plant for effective, environmentally compatible utilisation of CO₂. This project developed by Bayer MaterialScience, Bayer Technology Services, RWTH Aachen University and other partners chemically bonds CO₂, which is used as a component in polyether polyols. The project is financed by the German Ministry for Education and Research (bmbf). Oxygen depolarized cathode (odc) technology based on common salt: use of odc technology at Bayer Material Science for industrial-scale chlorine manufacture; operational maturity of technology by 2013; reduction in electricity requirement of 30 to 50% compared with existing processes and thereby reduction in indirect CO₂ emissions; first sale of odc technology to third parties by 2015. Bayer Science & Education Foundation presents biannual Bayer Climate Award in recognition of pioneering interdisciplinary research on climate change.

Innovative use of new technologies: Establishment of structese® (Structured Efficiency System for Energy) energy management system to achieve sustainable and systematic reduction of CO₂ emissions in energy-intensive plant. By the end of 2009, structese® had been successfully installed in 16 plants, enabling energy savings of more than €10 million to be sustainably realised and documented. The method is to be applied globally to 60 of the company's most energy intensive production facilities worldwide by 2012. Also actively promoting the EcoCommercial Building-Programme; the first zero-emission building is the company kindergarten in Monheim in Germany. By using renewable energy and incorporating optimal insulation based on polyurethane

raw materials from Bayer MaterialScience, this building achieves an emission-neutral energy balance over the course of the year. The climate-neutral daycare center was honored with the 'Energy-Optimized Construction 2009' award from the German Federal Ministry of Economics and Technology.

Collaboration with government, trade associations, etc.: "F3 Factory" (Flexible, Fast and Future Factory) research consortium headed by Bayer Technology Services. EU-sponsored project where 25 competing companies and research institutes have been collaborating on the development of efficient and sustainable manufacturing processes. A demonstration center will become accessible to the public by the beginning of 2011.

Cooperates closely with the United Nations Environment Programme (UNEP), in whose Sustainable Building and Climate Initiative (SBCI) the company is intensively involved. As part of the Bayer Climate Program, hosts scholarships for German schoolchildren to attend a two-week sustainability camp in Pittsburgh, United States, focusing on climate protection and sustainability.

Reporting: GHG emissions reported using the Greenhouse Gas Protocol. Sustainability report uses GRI G3 standards, index provided. Reports to the CDP, included as the world's best company in the Carbon Disclosure Leadership Index.

"We intend to play a leading role in reducing the environmental impact of our industry. Our particular focus is on reducing energy consumption and carbon dioxide emissions through innovative products and new, future-oriented applications in process engineering and development. These are projects that will benefit people both today and in the future.

We provide innovative materials for zero-emission houses as part of the Eco-Commercial Building Program. This program shows how we are actively putting climate protection into practice."

Patrick Thomas
Chairman of the Board of Management
Bayer MaterialScience AG

Featured Company: E. I. du Pont de Nemours and Company (DuPont)

Key achievements and targets: Between 1990 and 2007, has reduced GHG emissions measured as CO₂ equivalents by 72%.

Goals for 2015 include:

- Further reduce GHG emissions at least 15% from a base year of 2004. Progress (2007): Overall down 6% since 2004.
- Ensure that 100% of off-site fleet of cars and light trucks use 'leading technology for fuel efficiency and fossil fuel alternatives'. Progress (2007): 22% of US vehicles using 'leading technology'
- Hold energy use flat using 1990 as a base year. Progress (2007): Down 9% with 40% increase in product volume.
- Double investment in R&D programs with direct, quantifiable environmental benefits for customers and consumers along value chains. 2007 Progress: Baseline established. Goal is set at \$640 million.

Research directions: Global thin film photovoltaic research and development; in 2009 a new center opened in the Hong Kong Science Park in China and a new photovoltaic technical center was opened as part of the company's R&D center in Shanghai, China. Next generation biofuels.

Innovative use of new technologies: Installation of Ethylene Dryer facilities and optimisation of production schedules resulted in an annual emissions reduction of

34 million pounds of CO₂. Supplied Zytel® nylon resin to replace steel in exhaust system parts on all Volkswagens built on the current Golf platform, cutting component weight nearly 50%.

Collaboration with government, trade associations, etc.: Diverse, including the following: Founding member of the United States Climate Action Partnership. Charter member of the Chicago Climate Exchange, the world's first voluntary, legally binding, GHG emissions reduction and trading system. Member of the Global Roundtable on Climate Change, the US EPA Climate Leaders, the US EPA Power partnership, Business Roundtable's Climate Resolve.

Green product offerings: Target to increase annual revenues from products that create energy efficiency and/or significantly reduce greenhouse gas emissions reductions for customers by \$2 billion by 2009. DuPont estimates these products will contribute at least 40 million tonnes of additional CO₂ equivalent reductions by customers and consumers.

Products include: Engineering Polymers materials contributing to make vehicles lighter; Nomex® Paper and Pressboard, used in transformers in wind turbines; Nomex® Paper and PEN film laminate used in hybrid vehicles, TiPure® 902+ a titanium dioxide powder that requires less dispersion time and uses less associated energy, and CyrelFAST® thermal platemaking printing systems.

DuPont Sustainable Solutions, including DuPont Clean Technologies (DuPont™ BELCO® Clean Air Technologies, Global Engineered Solutions to improve plant performance) and DuPont Sustainable Operations (consulting around environmental management, energy efficiency, and sustainable assets).

Using lifecycle analysis tools to better understand the full lifecycle cost and impact of select DuPont products and to identify solutions that would help minimise the environmental impact throughout our value chains.

Reporting: Reports to the Carbon Disclosure Project; uses the methodologies specified in the WRI Greenhouse Gas Protocol to calculate GHG emissions.

Renewable Energy: 2015 goal: source 10% of energy use from renewable sources at a cost competitive with the best available fossil fuels. 2007 Progress: 6% of energy from renewable sources. For example, one site in the US installed a dual fuel operated boiler, using landfill gas as the new fuel, which reduced fossil fuel use by 4% annually. Also renewable products, including current and next-generation biofuels, and diverse products used in photovoltaic (PV) solar cells.

“Business is being challenged not only to better manage its impact on the environment but also to bring a different type of product to market.”

Ellen Kullman
Chairman & Chief Executive Officer
DuPont

Featured Company: Evonik Industries AG*

*profile focuses primarily on the company's chemicals business area.

Key achievements and targets: Total GHG emissions by the chemicals business area declined by nearly 4% in 2008 to 8.37 million metric tonnes CO₂ equivalents. Relative to output, emissions declined by 2%.

40% of the chemical business area's CO₂ emissions are process-related. Process-related emissions contracted by 6% year-on-year in 2008 to 3.33 million metric tonnes and decreased 5% relative to output.

Energy-related CO₂ emissions were 2% lower in 2008 than in 2007 at 4.95 million metric tonnes. Specific emissions (i.e. emissions relative to output) declined by 1%. Improved efficiency in the generation and supply of energy was partially offset by strong growth in output of energy-intensive products.

Research directions: Working with Daimler AG to drive forward research, development, production and commercialisation of the lithium-ion cells and battery systems required by tomorrow's lower emissions vehicles, including hybrids and those powered by batteries or fuel cells. Developing new and improved functional surfaces, films and semi-finished products, for example for the photovoltaics sector. Enhancing use of renewable raw materials. Eco2 S2B Research Center for energy efficiency and climate protection; projects include

- Carbon capture and use: partial absorption of CO₂ from flue gases using tailor-made absorbents so the CO₂ can be re-used as a starting product for chemical production.
- Energy generation: a low-cost, decentralized method of methane enrichment of biogas which can be fed into the natural gas network.
- Energy storage: control methods that make sensible use of the benefits of innovative storage technologies such as lithium-ion batteries, allowing more efficient power generation from wind and solar energy and the development of electric automobiles.
- Energy-efficient customer solutions: development of systems for buildings that provide a smart link between insulation and energy generation.

Innovative use of new technologies: Investing in efficiency measures integrated into plants and processes. As example: in Rheinfelden (Germany) a new heat exchanger cycle utilises exhaust heat from the AEROSILR

production process to preheat air for percarbonate drying, thus saving valuable fossil fuels.

Together with SolarWorld AG, Bonn (Germany), Evonik has developed a new, more energy efficient production process for ultra-pure polycrystalline solar silicon (PCS), including innovative deposition technology based on monosilane (SiH₄).

Collaboration with government, trade associations, etc.: Member of the UN Global Compact. Involved in ELAN 2020, a cross-sector initiative to promote electric mobility.

Green product offerings: Building block chemicals (chlorosilanes and monosilane (SiH₄)) for the solar power sector and other materials for the solar industry. Various Plexiglass® applications, including uses as part of solar collectors, the Sunshower™; multi-skin sheets as greenhouse insulation; and transparent lamellar sunblinds which reflect direct sunlight, keeping out the heat of the sun but allowing diffuse daylight to enter the room. Polyurethane insulation materials. Materials for next generation LEDs.

Reporting: Corporate Responsibility Report based on GRI G3 guidelines and includes an index.

Renewable energy: Researching technology for fuel cell and electric applications in the automobile industry, providing applications for solar technologies.

“Evonik's ideas and activities are clearly focused on the future. We see that as part of our corporate responsibility. We proactively address megatrends such as Energy Efficiency, Globalization & Demographic Change and Health & Wellness as a basis for driving forward our business and moving into promising new markets. We therefore offer customers high quality products and solutions that help reduce the consumption of natural resources, make more efficient use of energy and cut CO₂ emissions.”

Dr. Klaus Engel, Chairman of the Executive Board
Evonik Industries AG

Featured Company: LyondellBasell Industries

Key achievements and targets: In 2006, the company's Energy Management Team set a goal to reduce energy use by 2% each year for the next five years. As of 2009, the goal had been exceeded, with energy use reduced by 7.7%. Achieving the energy goal will reduce emissions by 2 million tonnes.

In 2009, used 316 million GJ of energy, a reduction of 10% compared with 2008. Some savings were due to reduced production, however of the 35 million GJ reduction for 2009, more than 29 million GJ was due to better energy maintenance, energy measurement and equipment upgrades.

Using more efficient cogeneration (steam and electricity) facilities to reduce energy consumption.

Wide variety of energy-conservation practices, including improved convection leading to higher furnace efficiency, advanced process control and energy management to optimize energy consumption, high-efficiency electrical equipment which reduces power consumption, efficient lighting which provides more lumens of light with less power consumption.

Innovative use of new technologies: By sealing tube supports at a Corpus Christi, US plant, cold air is kept from entering the furnace — producing annual savings of more than \$3 million. By installing a distributed control system on a purification column at a Channelview, US, plant, the need for steam is reduced, producing annual energy savings of \$1.1 million.

Collaboration with government, trade associations, etc.: Participating in industry forums that address climate protection and environmental impact along the supply chain, including International Council of Chemistry Associations, Plastics Europe, Association of Postconsumer Plastics Recyclers (US), Society of the Plastics Industry (US), Plastics and Chemicals Industry Association (Australia), WRAP (UK).

Green product offerings: Designs and licenses energy-saving innovations in polymer and chemical technologies. For example, the Spheripol process, the world's top polyolefin technology, offers customers the lowest operating costs in the industry, partly due to its reduced power consumption. Several technologies integrate heat and power, thereby reducing overall energy consumption.

“We are committed to protecting the environment, human health and safety and the communities where we operate... We likewise have dedicated ourselves to minimizing our emissions and improving our energy efficiency. We are making the investments necessary to accomplish this goal through cost-effective compliance, business-driven improvement and science-based risk management.”

Jim Gallogly, Chief Executive Officer
LyondellBasell Industries

Featured Company: Mitsubishi Chemicals Holding Corporation (MCHC)

Key achievements and targets: Goal to cut unit energy consumption by at least 20% relative to FY1990 by FY2010.

Plant level initiative to spur energy conservation ideas at the Mitsubishi Chemicals Corporation (MCC) Mizushima Plant; in FY 2008, roughly 20 ideas produced, including the idea to reuse heat waste for heating, which would contribute to the reduction of CO₂ emissions by approximately 60,000 metric tonnes. In FY 2009, assessing feasibility of implementation and rolling out similar activities at other plants.

In FY 2008, enhanced steam trap management, reuse of heat waste and use of pump and blower inverters achieved 36,000 kl of crude oil equivalent energy efficiency, resulting in a reduction of 179,000 kl of crude oil equivalency compared to the previous fiscal year.

MCC (non-consolidated) CO₂ emissions totaled 7610,000 metric tonnes, a reduction of 510,000 metric tonnes compared to FY 2007 and a 20% reduction compared to fiscal 1990 levels. Overall group emissions were reduced by 6.4% compared to the previous fiscal year, although unit energy consumption increased due to reduced production volumes as a result of the global recession.

Initiatives also underway to reduce CO₂ emissions from shipping. In 2009, fins added to ships increasing fuel efficiency by an average of 5%; also installed on-board terminals and eco-tires to promote environmentally friendly driving. Since 2008, increasing lot volumes shipped by vessel and tank truck. Goal to reduce energy consumption units by 1% annually (as mandated by the Japanese government) in the medium- to long-term

through initiatives to reduce CO₂ emissions with the group's main logistics contractor, Mitsubishi Chemical Logistics.

MCHC Group also promoting energy saving initiatives at home and in the office.

Research directions: Development of proprietary bio-based polymers, development and supply of LED materials.

Innovative use of new technologies: Development of Li-ion battery (LiB) materials for use in hybrid electric vehicles; proprietary technologies for material design, chemical reaction control, and battery evaluation now being applied to develop electrolytes, cathodes, anodes, and separators for the LiB.

Supplied cutting-edged chemical technologies such as carbon fiber for the body, photovoltaic modules and Lithium-ion secondary battery for the driving power supply and LED, for the KAITEKI, a three-wheeled bicycle equipped with an assist motor. The KAITEKI began as an employee idea.

Green product offerings: White LEDs, Li-ion battery materials for hybrid electric vehicles, chemical components for lighter weight automobiles, organic photo semiconductors, and organic photovoltaic modules.

Reporting: Uses GRI-G3 reporting guidelines (as well as those of the Japanese Ministry of the Environment). Also uses an Eco-efficiency index which calculates revenue/ environmental load, including GHG emissions among other factors.

“Identifying greenhouse gas reduction as one of its core management strategies, the MCHC Group is striving to realize a “KAITEKI (‘comfort’ in Japanese)” world – in which people can enjoy comfort, affluence, safety and security – underpinned by a sustainable society.

As a major producer of the MCHC Group’s overall CO₂ emissions, we play a critical role in achieving CO₂ reduction targets. In this context, our focus is on bringing to market environmentally conscious products and technologies, as well as raising production efficiency at our plants, and conserving energy. Moreover, we will strive to develop more effective and relevant environmental measures while deepening our dialogue with local communities and customers.

In specific terms, we will make concerted efforts to ensure the early commercialization of next-generation growth businesses based on cutting-edge technologies that contribute

to energy conservation and the reduction of greenhouse gas emissions. These efforts are being applied in such products fields as white LEDs, Li-ion battery materials for hybrid electric vehicles, chemical components for lighter weight automobiles, sustainable resources, organic photo semiconductors, and organic photovoltaic modules.

As a chemical company that has continued to challenge new boundaries in the development of wide ranging technologies while handling carbon products, the MCC Group is convinced that environmental issues may be resolved dramatically by leveraging the wisdom of chemistry. In this context, we are endeavoring to create a neo carbon society that makes full use of carbon and its vast potential.”

Yoshimitsu Kobayashi
Representative Director, Member of the Board,
President and Chief Executive Officer
Mitsubishi Chemical Corporation

Featured Company: The Dow Chemical Company (Dow)

Key achievements and targets: Additional, cumulative energy intensity and bottom line cost savings in 2009. Since 1990, Dow has reduced its energy intensity by 38%. And, since 1994, the Company has saved over 1,700 trillion Btu of energy, enough to supply the residential electrical needs of the state of California for one year.

From 1994-2009, Dow reduced its absolute GHG emissions by 20%— well beyond Kyoto targets. Through the end of 2009, savings due to improved energy intensity now exceed \$9.2 billion.

2015 Goals include: Reduce GHG intensity 2.5% per year from 2005 to 2015 and reduce energy intensity by 25%.

2025 Goals include: Reduce absolute emissions within the company.

Absolute emissions have been reduced in 2007, 2008 and 2009; 2009 absolute GHG emissions were down 5% from 2008.

Research directions: Carbon capture; for example, working with Algenol Biofuels to build and operate a pilot-scale algae-based integrated biorefinery that will convert CO₂ into ethanol. The company plans to locate the facility at Dow's Freeport, Texas site.

Innovative use of new technologies: Using ground-breaking, patented flare technology to achieve dual benefits of delivering cost savings while significantly reducing GHG emissions. The technology uses hydrogen rather than methane to supplement gas flowing to flares to eliminate waste gases at manufacturing sites. Dow estimates the process will save more than \$10 million during the next 10 years and eliminate 27,000 metric tonnes of emissions each year.

Collaborated with Cobblestone Homes to introduce Michigan's first, affordable net-zero energy home which uses a wide range of Dow materials and sustainable technologies, including next generation insulation and air-sealing products, and DOW™ POWERHOUSE™ Solar Shingles.

Collaboration with government, trade associations, etc.: Member of the United States Climate Action Partnership (USCAP), numerous research partnerships with academia; for example, a multi-year research collaboration with the California Institute of Technology (Caltech) to jointly develop new, ultra low-cost, high efficiency photovoltaic materials, and a joint research project with the King Abdullah University of Science and Technology (KAUST) in Saudi Arabia.

Green product offerings: DOW™ POWERHOUSE™ Solar Shingles; Extruded polystyrene foam (XPS) (STYROFOAM™ brand insulation), used as thermal insulation in residential and commercial buildings; Rigid polyisocyanurate (ISO or ISO boardstock) foam (THERMAX™ insulation) used as thermal insulation in residential and commercial buildings. Rigid polyisocyanurate foam (TRYMER™ polyisocyanurate foam) and extruded polystyrene foam (STYROFOAM™ brand pipe insulation billets) used as thermal insulation in commercial pipe applications.

Reporting: Provides a GRI report using the G3 guidelines; quarterly updates on progress posted on company website.

Dow believes that providing humanity with a sustainable energy supply while addressing climate change is one of the most urgent environmental issues the world faces. Dow will contribute to slowing, stopping and reversing the growth of our green house gas (GHG) footprint by reinventing the way we apply chemistry and will lead the global call for a multi-faceted approach to energy and climate change. As a world leader in chemistry, we are uniquely positioned to deliver solutions to energy alternatives, less carbon intensive raw material sources, and other solutions not yet imagined.

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