

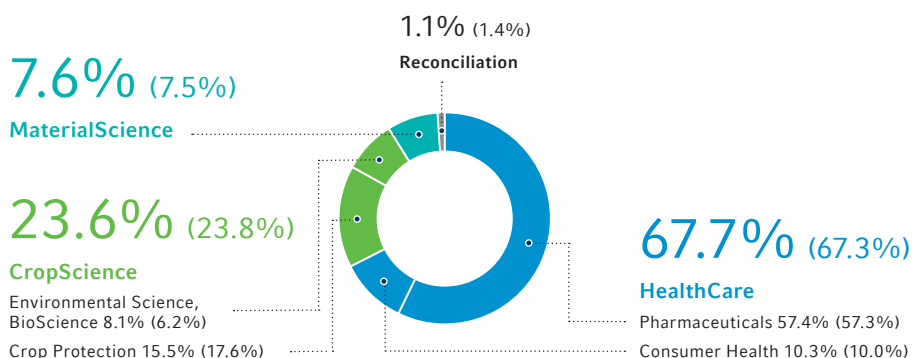
8. Research and Development

Our mission “Bayer: Science For A Better Life” underscores Bayer’s belief that innovation has a major role to play in addressing the global challenges of providing health care and nutrition for the world’s growing population and conserving dwindling resources. Innovation will therefore remain a key driver of the company’s growth in the future. Bayer has the resources at its disposal to continuously renew and expand its portfolio and optimize production processes through research and development. In 2010 we invested the record sum of €3,053 million – equivalent to 8.7% of sales – in research and development, compared with €2,746 million in the previous year. Our research and development activities are closely aligned to market needs and geared toward continuous improvement. Our own activities are supplemented by an international network of collaborations with leading universities, public-sector research institutes and partner companies that we continue to expand in alignment with our main areas of research and development. This network allows the pooling of expertise, helping us to rapidly translate new ideas into successful products. Another core element of our activities is the continuous development of the 13,200 individuals working in research and development throughout the Bayer Group.

€3.1 billion
for research and development

Share of Research and Development Expenses by Segment (2009 in parentheses)

[Graphic 3.17]



HEALTHCARE

In 2010 we invested €2,066 million (2009: €1,847 million) in research and development (R&D) in the Pharmaceuticals and Consumer Health segments. This represented 67.7% of the Bayer Group’s entire research and development expenditures and was equivalent to 12.2% of HealthCare sales. The number of HealthCare subgroup employees working in research and development at the time this report was finalized was 7,700.

In the Pharmaceuticals segment we increased our R&D expenditures to €1,751 million (2009: €1,572 million), or 16.1% (2009: 15.0%) of sales. Drug discovery in the Pharmaceuticals segment focuses on the areas of cardiology, diagnostic imaging, oncology and women’s healthcare. The respective research activities and capacities are concentrated at three main sites in Berlin and Wuppertal, Germany, and Berkeley, California, United States. Work in Berlin and Wuppertal centers largely on identifying molecular targets and developing and optimizing lead compounds. Research is also carried out at these sites in the fields of drug metabolism, pharmacokinetics, toxicology and clinical pharmacology. Berkeley is a major research and development center in which protein-based biological research on the active ingredient Kogenate® takes place. In 2010 the global research network was strengthened by the opening of an innovation center near San Francisco, California, United States, for hematology research and the development of novel biological active substances. At this center, university research institutes and young biotechnology companies will work closely with our scientists. In addition, we established a new international R&D center in Beijing, China, to contribute to the research and development of medicines for China and other Asian countries. At both centers we are seeking strategic alliances with selected research and development partners.

€2,066 million
for research and development at HealthCare

To drive the development of new substances for treating diseases with a high unmet medical need, we conducted clinical studies with several drug candidates from our research and development pipeline during 2010. Following the completion of all necessary studies, we submitted applications to one or more authorities for registration or registration extensions for some of these drug candidates. The most important drug candidates currently in the registration process are:

Products in Registration

[Table 3.33]

| | Indication |
|----------------------------|---|
| Gadovist® | U.S.A., magnetic resonance imaging, central nervous system |
| Qlaira®/Natazia™ (E2V/DNG) | U.S.A., treatment of heavy and/or prolonged menstrual bleeding |
| Valette® Plus | E.U., oral contraception, combination product with folate |
| Xarelto® | Stroke prevention in atrial fibrillation |
| Xarelto® | E.U., treatment and secondary prevention of deep vein thrombosis |
| Xarelto® | U.S.A., prevention of venous thromboembolism following elective hip or knee replacement surgery |
| YAZ® Flex | E.U., oral contraception, flexible dosage regimen |

The following table shows our most important drug candidates currently in Phase III or II of clinical testing:

Research and Development Projects (Phases III and II)*

[Table 3.34]

| | Indication | Status |
|------------------------------------|---|-----------|
| Alemtuzumab | Multiple sclerosis | Phase III |
| Alpharadin™ | Treatment of bone metastases in hormone-refractory prostate cancer | Phase III |
| ATX-101 | Reduction of submental fat | Phase III |
| FC Patch low | Contraception | Phase III |
| Florbetaben | PET imaging in diagnosis of Alzheimer's disease | Phase III |
| Gadovist® | Magnetic resonance imaging | Phase III |
| LCS (ULD LNG contraceptive system) | Contraception | Phase III |
| Nexavar® | Breast cancer | Phase III |
| Nexavar® | Thyroid cancer | Phase III |
| Nexavar® | Non-small-cell lung cancer | Phase III |
| Regorafenib (DAST inhibitor) | Treatment of metastatic or inoperable gastrointestinal stromal tumors | Phase III |
| Regorafenib (DAST inhibitor) | Colon cancer | Phase III |
| Riociguat (sGC stimulator) | Pulmonary hypertension (CTEPH) | Phase III |
| Riociguat (sGC stimulator) | Pulmonary hypertension (PAH) | Phase III |
| Xarelto® | Prevention of venous thromboembolism in medically ill, immobilized patients | Phase III |
| Xarelto® | Treatment and secondary prevention of venous thromboembolism | Phase III |
| Xarelto® | Secondary prevention of acute coronary syndrome/myocardial infarction | Phase III |
| Vaginorm® | Vulvovaginal atrophy and female sexual dysfunction (FSD) | Phase III |
| VEGF Trap-Eye | Wet age-related macular degeneration | Phase III |
| VEGF Trap-Eye | Abnormal retinal angiogenesis following pathological myopia | Phase III |
| VEGF Trap-Eye | Central retinal vein occlusion | Phase III |

Research and Development Projects (Phases III and II)*

[Table 3.34 (continued)]

| | Indication | Status |
|-------------------------------|---|----------|
| Alpharadin™ | Treatment of bone metastases in breast cancer | Phase II |
| Amikacin Inhale | Pulmonary infection | Phase II |
| BAY 60-4552/ildenafil | Erectile dysfunction | Phase II |
| Cinaciguat (sGC activator) | Acute heart failure | Phase II |
| Ciprofloxacin Inhale | Pulmonary infection | Phase II |
| Mapracorat (ZK 245186, SEGRA) | Atopic dermatitis | Phase II |
| MEK inhibitor | Cancer | Phase II |
| Nexavar® | Breast cancer | Phase II |
| Nexavar® | Colon cancer, combination therapy | Phase II |
| Nexavar® | Ovarian cancer | Phase II |
| Nexavar® | Additional indications | Phase II |
| Regorafenib (DAST inhibitor) | Cancer | Phase II |
| Riociguat (sGC stimulator) | Pulmonary hypertension (COPD) | Phase II |
| Riociguat (sGC stimulator) | Pulmonary hypertension (ILD) | Phase II |
| Riociguat (sGC stimulator) | Pulmonary hypertension (LHD) | Phase II |
| VEGF Trap-Eye | Diabetic macular edema | Phase II |

*as of February 15, 2011

PAH = pulmonary arterial hypertension; CTEPH = chronic thromboembolic pulmonary hypertension

COPD = chronic obstructive pulmonary disease; ILD = interstitial lung disease; PET = positron emission tomography

LHD = left heart disease

The nature of drug discovery and development is such that not all compounds can be expected to meet the pre-defined project goals. It is possible that any or all of the projects listed above may have to be discontinued due to scientific and/or commercial reasons and will not result in commercialized products. It is also possible that the requisite FDA, European Medicines Agency (EMA) or other regulatory approvals will not be granted for these compounds.

We regularly evaluate our research and development pipeline in order to prioritize and advance the most promising pharmaceutical projects.

Our novel anticoagulant Xarelto®, a direct Factor Xa inhibitor in tablet form, was launched onto the market in September 2008 for prophylaxis of venous thromboembolism (VTE) in adult patients following elective hip or knee replacement surgery. Bayer has received marketing authorization for this indication from health authorities in more than 100 countries around the world, including the E.U. member states, Australia, China, Canada and Mexico. Xarelto® is now on the market in over 75 countries. In a Phase III trial investigating Xarelto® in long-term treatment and secondary prevention of deep vein thrombosis, a novel, simplified therapeutic approach based on Xarelto® as a single-entity therapy demonstrated comparable efficacy to the current standard therapy and thus met the primary efficacy endpoint. In January 2011, based on the positive results of the registration-relevant, double-blind Phase III ROCKET AF trial, we submitted Xarelto® to the European Medicines Agency (EMA) for E.U. marketing authorization for stroke prevention in non-valvular atrial fibrillation and the treatment and secondary prevention of deep vein thrombosis, and our cooperation partner Johnson & Johnson submitted a New Drug Application to the U.S. Food and Drug Administration (FDA) for market authorization for stroke prevention in non-valvular atrial fibrillation. The extensive clinical trial program supporting Xarelto® makes it probably the most intensively studied oral, direct Factor Xa inhibitor in the world today. More than 65,000 patients will be enrolled into the clinical development program for this drug substance, which will evaluate the product in the prevention and treatment of thrombosis in a broad range of indications (see also Table 3.34).

Xarelto®:
applications submitted
for new indications

Based on positive Phase II trial outcomes with riociguat, the first member of a new class of vasodilating agents known as soluble guanylate cyclase (sGC) stimulators, we moved into Phase III trials with this substance in December 2008. Administered in tablet form, riociguat is currently being investigated as a new approach for the treatment of various forms of pulmonary hypertension.

Our development projects also include the innovative cancer drug Nexavar®, which we are jointly further developing with Onyx Pharmaceuticals, Inc., United States. The promising active substance sorafenib, which attacks both cancer cells and the vascular system of the tumor, is already being marketed worldwide to treat advanced renal cell carcinoma and hepatocellular carcinoma. Nexavar® is currently in various stages of clinical testing for the treatment of further tumor types. A Phase III study involving Nexavar® in combination with two chemotherapeutics commonly used in Europe compared to chemotherapy alone did not reach its primary endpoint – extension of overall survival – in patients with advanced non-small-cell lung carcinoma. Nexavar® continues to be investigated by Bayer and Onyx as well as independent scientists in the treatment of lung cancer in a variety of settings (see also Table 3.34).

With regorafenib we launched a Phase III program in April 2010 for treatment of advanced colorectal cancer. Regorafenib is a novel, oral multi-kinase inhibitor that inhibits various signaling pathways responsible for tumor growth. We are enrolling patients with metastatic colorectal carcinoma whose disease is progressing despite previous standard treatments.

In the field of women's healthcare we are conducting research in the field of gynecological therapies to expand the range of contraceptive options. Phase III clinical trials began in April 2009 with a contraceptive patch, intended to become the only transparent product of its kind and the smallest, lowest-dosed contraceptive patch on the market. Vaginorm®, a development product of our new collaboration with EndoCeutics, is being developed for the treatment of vaginal atrophy and female sexual dysfunction. Vaginorm® is currently being investigated in a Phase III trial program in Canada and the United States. It contains dehydroepiandrosterone (DHEA), a precursor of female and male sex hormones. Also undergoing Phase III development is the new hormone-releasing intrauterine device LCS, which is smaller than Mirena®, contains a lower hormone dose and is effective for up to three years.

The contraceptives YAZ® Plus and Yasmin® Plus, which each contain folate in addition to the hormonal components, were registered in the United States under the trade names Beyaz® and Safyral™, respectively. Our new oral contraceptive, marketed in Europe since May 2009 under the name Qlaira®, was registered in the United States as Natazia™ in the second quarter of 2010. The additional indication for treatment of heavy and/or prolonged menstrual bleeding was registered in Europe in October and has also been submitted for registration in the United States. Qlaira®/Natazia™ is the first product in a new class of oral contraceptives whose estrogen component is based on estradiol.

Our research activities in the area of diagnostic imaging are focused on the development of positron emission tomography (PET) tracers that could enable earlier and more accurate diagnosis of diseases in the future. Here, we are concentrating on three indications: central nervous system disorders, oncology and cardiovascular disease. With the development of the PET tracer florbetaben, we aim to contribute to earlier and more accurate diagnosis of Alzheimer's disease. Bayer launched the global Phase III program for florbetaben in November 2009.

We supplement our development product portfolio from our own R&D activities through targeted inlicensing.

Inlicensing complements our development portfolio

In June 2010 we formed a strategic alliance with OncoMed Pharmaceuticals, Inc., United States, to research, develop and market novel therapeutics to control cancer stem cells, which are believed to play a significant role in the emergence, metastasis and recurrence of cancer.

The collaboration formed in March 2010 with the u.s. specialty pharmaceutical and diagnostics company Prometheus Laboratories Inc. is aimed at the development of a diagnostic platform in cancer therapy. The purpose of the platform is to match patients with suitable drug candidates, thereby opening up new options for personalized cancer therapy in the future.

In collaboration with Genzyme Corp., United States, we are developing the humanized monoclonal antibody alemtuzumab, which is currently being tested in two global Phase III studies for the treatment of multiple sclerosis (MS).

The VEGF Trap-Eye joint developmental project with Regeneron Pharmaceuticals, Inc., United States, has achieved positive results in two parallel Phase III studies in wet age-related macular degeneration (AMD). Based on these data, we plan to file for marketing authorization in Europe and the United States together with Regeneron in the first half of 2011. VEGF Trap-Eye is also currently undergoing Phase III clinical development for the treatment of central retinal vein occlusion (CRVO), another frequent cause of blindness. In addition, a Phase II study in the treatment of diabetic macular edema (DME) is being conducted. VEGF (vascular endothelial growth factor) is a natural growth factor that stimulates the formation of new blood vessels (angiogenesis). VEGF Trap-Eye blocks this growth factor specifically and very effectively, thus preventing the abnormal formation of new blood vessels that tend to leak blood. The medication is administered directly into the eye. Once the product has been granted regulatory approval, Bayer will market it outside the United States. Regeneron Pharmaceuticals, Inc., United States, retains exclusive commercialization rights to VEGF Trap-Eye in the U.S.

In September 2009 Bayer licensed Alpharadin™, an alpha-emitting radiopharmaceutical, from Algeta ASA, Norway, for joint development and marketing as a potential cancer therapy. The substance is currently being evaluated in a global Phase III trial for the treatment of bone metastases in prostate cancer patients who no longer respond to hormone therapy. In 2010 the development program for Alpharadin™ was expanded to include a Phase II study in breast cancer patients with bone metastases.

We also invest in continuous life-cycle management to identify possible additional indications and improved delivery forms for products already on the market. For example, the U.S. Food and Drug Administration (FDA) has approved STAXYN™, a new formulation of our drug Levitra®. This is an orodispersible tablet that can therefore be taken without liquid. We have also received marketing authorization for the new formulation in Europe under the trade name Levitra®.

Life-cycle management
for products already on
the market

In the Consumer Health segment we increased our R&D expenditures to €315 million (2009: €275 million), or 5.2% (2009: 5.0%) of sales. In our Consumer Care Division, research and development activities at our product development centers in Morristown, New Jersey, United States, and Gaillard, France, concentrate on identifying, developing and commercializing non-prescription (over-the-counter = OTC) products. These efforts center on supporting both existing and new brands by implementing product-specific, clinical and regulatory development strategies that enable the successful exploitation of new technologies, the expansion of indications for existing products or the reclassification of current prescription medicines as OTC products. We introduced a variety of new product line extensions to several markets in 2010, such as the combination product Bayer® AM (active ingredients: acetylsalicylic acid and caffeine), new nutritionals (especially for menopausal women and performance-oriented men) sold under the One A Day® brand in the United States, and the antacid Mopralpro® in France. In the area of prescription dermatology products, we entered into a licensing and development agreement with U.S.-based KYTHERA Biopharmaceuticals, Inc., concerning the joint development of a substance for use in aesthetic dermatology.

The research and development activities of our Medical Care Division focus on blood glucose monitoring and the continuing development of medical equipment used in the diagnosis or treatment of various diseases. At the four U.S. research and development centers for our diabetes care business, the largest of which is in Tarrytown, New York, we are working to strengthen our product lines and continue our expansion into attractive segments of the diabetes market. In 2010 we progressed with the launch of several innovative products in key markets to meet specific needs of individuals with diabetes, including Contour® USB with integrated diabetes management software and the option of direct computer connection (plug & play), the diabetes management software Glucofacts® Deluxe, and A1CNow™ SelfCheck, which is used to determine long-term blood glucose values (A1c). The research and development activities for our medical equipment business focus on continuous enhancement of our contrast injection, thrombus removal and other vascular intervention systems. We also aim to enter additional attractive segments such as medical data management tools for contrast injection systems, and drug-eluting balloon catheters to treat vascular disease. The respective research and development centers are located near Pittsburgh, Pennsylvania, and Minneapolis, Minnesota, in the United States and in Sydney, Australia.

The Animal Health Division focuses its research and development activities in Monheim, Germany, on anti-infectives and parasiticides along with active substances for the treatment of non-infectious disorders in animals. Besides the development of new products to control parasites in companion animals and livestock, we continue to expand the product portfolio to treat chronic kidney diseases, cardiovascular disease and cancer in dogs and cats. A number of product line extensions also received approval in various markets. In the United States, for example, Advantage® was registered additionally for the prevention and treatment of flea and tick infestation in dogs.

€722 million

for research and
development
at CropScience

CROPSCIENCE

In 2010, €722 million (2009: €653 million) in research and development expenditures, or 23.6% of the Bayer Group total, were made in the CropScience subgroup. This was equivalent to 10.6% of subgroup sales.

CropScience maintains a global network of research and development facilities employing some 4,300 people. Our largest R&D sites for crop protection products are located in Monheim and Frankfurt am Main, Germany, and in Lyon, France. The major research centers of the BioScience unit, which focuses on seed technology and breeding, are located in Ghent, Belgium; Haelen, Netherlands; and Morrisville, North Carolina, United States.

While research is carried out centrally at a small number of sites, our development and seed breeding activities take place both at these sites and at field testing stations across the globe so that future active substances and crop varieties can be tested according to specific regional requirements.

As part of our integrated research approach, scientists in the fields of agricultural chemistry and seed technology are increasingly collaborating to pool the knowledge acquired through chemical, biological and genetic research and field development, aligning this expertise to our long-term research objectives and business strategies for the various crops.

In the Crop Protection segment we spent €476 million (2009: €482 million) for research and development in 2010. In this segment we identify and develop innovative, safe and sustainable products for use in agriculture as insecticides, fungicides, herbicides or seed treatments, and carry out research projects across all indications in new areas of future importance, such as plant health or stress tolerance. In addition to conventional chemistry, biology and biochemistry, modern technologies such as genomics, high-throughput screening and bioinformatics play an important role in identifying new chemical lead structures. Collaborations with external partners complement our own activities.

We broaden the range of uses for our products by developing new mixtures or innovative formulations of products already on the market so that they can be applied in additional crops or be made easier to handle.

The active ingredient pipeline of Crop Protection currently contains 13 development projects, of which nine are at an advanced stage and four at an early stage of development. A further 38 projects are in earlier research stages.

In 2010 we successfully commercialized our new rice fungicide isotianil (major brand: Routine®), a member of the isothiazole chemical class, in South Korea and Japan. This product will strengthen our portfolio in Asia. The active ingredient originating from our research pipeline was further developed in collaboration with Sumitomo Chemical Co., Ltd. of Japan. Isotianil protects rice against *Pyricularia oryzae*, the fungus that causes rice blast, by stimulating the plants' natural defense mechanisms.

We also successfully launched *Bacillus firmus* (major brand: Votivo™), a biological pest control agent for seed treatment applications, in the u.s. market. This product adds to our portfolio of conventional seed treatments to combat nematodes – threadworms that live in the soil.

We plan to launch four more promising new active ingredients in 2011-2012, subject to their successful registration:

Planned Product Launches

[Table 3.35]

| New active ingredient | Use | Planned launch |
|-----------------------|--------------------------|----------------|
| Bixafen | Fungicide | 2011 |
| Fluopyram | Fungicide | 2011 |
| Indaziflam | Herbicide | 2011 |
| Penflufen | Seed treatment fungicide | 2012 |

CropScience anticipates a peak sales potential totaling in excess of €1 billion for isotianil, *Bacillus firmus* and the four substances listed above that are expected to be commercialized by 2012.

Fluopyram (major brand: Luna®) has been developed to combat problematic plant diseases caused by fungal pathogens. It is planned to market this active ingredient – a member of the new pyridinyl-ethyl-benzamide class – worldwide for foliar application and seed treatment in more than 70 crops. Key benefits are better storability and longer shelf life of harvested produce.

Bixafen (major brands: Aviator®, Xpro®) is a new cereal fungicide that boosts yields thanks to its positive impact on plant physiology. This active ingredient, a member of the pyrazole class, was developed specifically for foliar application to combat speckled leaf blotch (*Septoria tritici*) and brown rust (*Puccinia recondita*). Representing a new group of active ingredients, bixafen is well suited as a component of resistance management.

Indaziflam (Alion®, Specticle®) is a new alkyazine herbicide with a long duration of action that is effective against a broad spectrum of difficult-to-control broad-leaf weeds and grasses. It is intended for use in agricultural specialty crops, such as fruit and grapes, and in numerous non-agricultural markets including weed control on paths and other paved areas.

Penflufen (Emesto®, Emerion®) is a novel pyrazole fungicide for use as a seed treatment in various crops, such as potatoes, oilseed rape/canola, soybeans, corn and cotton. This substance is effective against a number of seed-borne pathogens and features particularly broad action and efficacy against the fungus genus *Rhizoctonia*. Penflufen contributes to particularly strong seedling development due to its good seed tolerance.

In the Environmental Science, BioScience segment, we considerably raised our spending for research and development to €246 million (2009: €171 million). This increased expenditure was directed mainly toward expanding our research and development capabilities in BioScience.

The Environmental Science unit tests the compounds developed by Crop Protection and evaluates them for possible non-agricultural uses. In addition, we carry out tests with active ingredients from other companies and may purchase such ingredients if results are positive. Current development projects include gels and baits to combat insect pests, new herbicide and fungicide mixtures, biological solutions and products for insect vector control.

In 2010 the Natria™ product line was successfully launched in the United States and Germany. This new line of products based on natural or nature-derived ingredients complements the Bayer Advanced range in the United States and our 'Bayer Garten' portfolio in Germany. We plan to expand the product line and introduce it in France and other European markets during 2011. Following the submission of our Lifenet® mosquito net to the Pesticide Evaluation Scheme of the World Health Organization (WHOPEs) in 2010, we plan to start with the launch of this product in selected countries in 2011. A new insecticide formulation with residual action to control mosquitoes was also submitted to the WHO in 2010. As part of a further research collaboration between Crop Science and the Innovative Vector Control Consortium (IVCC) in Liverpool, United Kingdom, a new insecticides research platform was successfully established and yielded first results.

Research in our BioScience unit is dedicated to optimizing plant traits. We are developing new seed varieties of our established core crops – cotton, canola, rice and vegetables. We have expanded our research activities to include cereals and soybeans as additional core crops, and are conducting research to develop sugarcane varieties with an increased sugar content. Our research and development work focuses on improving the agronomic traits of these crops. For example, our scientists are working to develop crop plants with high tolerance against stress factors such as extreme temperatures and drought. We also aim to increase the plants' yield potential and quality of harvested materials. Examples here include improving the profile of canola oil or enhancing the properties of cotton fibers. Further areas of focus include developing new herbicide tolerance technologies based on alternative mechanisms of action, and improving the resistance of plants to damage from insects and disease. To do this we employ all modern breeding methods, including plant biotechnology techniques. Our BioScience research and development pipeline presently contains more than 60 promising lead projects and is complemented by around 80 current research agreements with public- and private-sector partners.

Business growth in BioScience is supported by new product introductions. An example is our LibertyLink® herbicide tolerance technology, marketed in the United States for soybean seeds in partnership with leading seed producers. In 2011 we plan to introduce several innovative seed varieties, including cotton with our proprietary glyphosate herbicide tolerance trait.

MATERIALSCIENCE

In 2010, MaterialScience spent €231 million (2009: €207 million) on research and development (not including joint development activities with customers). MaterialScience thus accounted for 7.6% of the Bayer Group's total research and development expenses. The subgroup's expenses in this field amounted to 2.3% of sales. 1,000 employees were entrusted with research and development tasks.

€231 million

for research and
development
at MaterialScience

Our focus in the field of Polyurethanes is on broadening the application areas for our products and improving their properties. A key area of application is in the construction industry, where rigid polyurethane foam serves as a highly efficient insulating material, making an active contribution to reducing energy consumption and protecting the climate. With many countries tightening their laws to reduce energy consumption in buildings, we anticipate growing demand for the relevant polyurethane foams in all climate zones, especially as they can provide significantly better thermal insulation than conventional insulating materials.

Polyurethane frames for photovoltaic units are another example of a groundbreaking application. Furthermore, in close cooperation with Puren GmbH of Überlingen, Germany, we have developed a system combining energy generation from solar radiation with highly efficient thermal insulation – thus satisfying two of today's key requirements for home construction.

The use of renewable raw materials also plays an important part in research and development activities. For example, a concept has been developed for a "green shoe," up to 90% of which consists of components manufactured by particularly environmentally friendly processes or using renewable raw materials. For example, the shoe sole is made of polyurethane produced mainly from soybean oil, and the toecap of a polycarbonate blend based partly on vegetable starch.

The focus of innovation in process development is on the production of new and improved raw materials and formulations. Specifically, MaterialScience is working with internal and external partners on ways to put climate-damaging carbon dioxide to good use in the manufacture of polyether polycarbonate polyol (PPP) feedstock for polyurethanes. Such intelligent use of CO₂ reduces our consumption of fossil raw materials and thus helps to protect the environment. This is made possible by a breakthrough in catalysis research based on the results of intensive cooperation between RWTH Aachen University and the CAT Catalytic Center in Aachen, Germany, operated jointly by MaterialScience and Bayer Technology Services.

Research and innovation in the area of polycarbonates focuses on the development of new polycarbonate products such as those for weight-saving applications, which set new efficiency and safety standards and allow greater design freedom.

We use the term "focused innovation" for activities in which we focus our resources on satisfying unmet customer needs in clearly defined growth areas. We refer to our activities in developing new solutions jointly with external partners as "open innovation." One example is the collaborative project to develop new, LED-based automotive lighting technologies that could significantly improve the energy efficiency of headlamp systems. Here we are working closely with a major automotive parts supplier, a producer of injection molding tools and the Fraunhofer Society, Europe's largest applied research organization. The "global innovation" concept denotes the intensive support provided by our polycarbonate product and applications development center in Leverkusen, Germany, for our development activities around the world.

Growth areas the focus of innovation

Our strategy focuses on selected development areas such as polycarbonate glazing and other lightweight solutions for the transportation sector, LED illumination management (for use in street lighting, for example), safety applications (such as safety glazing), and improvements in the cost efficiency of manufacturing processes. We also place importance on the continued development of highly eco-friendly materials, such as polycarbonate blends containing recycled plastics or bio-based substances. In this way we aim to help our customers achieve their sustainability goals.

The research and development departments of the Coatings, Adhesives, Specialties business unit drive forward the development of polyurethane raw materials for high-performance coatings, adhesives and sealants. A further objective of this business unit is to open up new technology-driven markets for our businesses with cosmetic and medical applications, functional films and nanotechnology. To this end we also maintain strategic alliances with partners from industry and academia.

The research and development activities serving our core businesses in conventional coating, adhesive and sealant raw materials are focused on the continued development of eco-friendly systems that are based on water rather than solvents or that can be efficiently radiation-cured. One example of a new market segment we have opened up for our products is our high-performance coating raw materials for wind turbines that can significantly improve the weather resistance of rotor blades.

Customized applications are also to be found in medical technology. In 2010 we combined our coating and adhesive materials portfolio for this sector under the brand name Baymedix®. Our offer includes highly functional coatings, special adhesive raw materials for wound care and closures, and thermoplastic polymers for surgical and diagnostic apparatus. In the field of cosmetics – where we develop precursors for facial and body care, hair styling and sun protection products – the new Baycusan® C product line satisfies important requirements for “green” raw materials, such as the absence of preservatives.

We have streamlined our research portfolio for functional films. Future activities will center partly around films based on polycarbonates or thermoplastic polyurethanes. Combining these with additional technologies or specific property profiles leads to new products such as multifunctional or holographic films, which open up new fields of application in a variety of industries. A modern coating line has been started up in Leverkusen for this purpose. Another area of focus is on electroactive polymers, where we have further strengthened our activities through the acquisition of the u.s. company Artificial Muscle, Inc. In 2010 we opened a new research center for functional films in Singapore, particularly to meet growing demand from the electronics market in Asia/Pacific for innovative film-based products.

Technology Services supports all Bayer subgroups with technology platforms

BAYER TECHNOLOGY SERVICES

All Bayer subgroups work closely with our service company Bayer Technology Services worldwide on technology solutions, particularly in the fields of process technology, plant engineering, automation and product development. For example, this service company cooperates with MaterialScience in the development of new production processes that make efficient use of energy and raw materials, thereby helping the subgroup to safeguard its technological and cost leadership. Examples include the new TDI production process being used for the first time at the MaterialScience site in Shanghai and the catalytic conversion of carbon dioxide to polymers. Centralized development work on technologies relevant to more than one subgroup, such as nanotechnology and biotechnology, along with expertise in mathematical simulation and statistical data analysis, helps HealthCare and CropScience to shorten development times for new products. This also includes the future development of entirely new production concepts, for example at the INVITE research center, a collaborative venture between Bayer Technology Services and Dortmund Technical University, which is currently under construction. Another key strategic factor here is international knowledge sourcing in areas ranging from country-specific expertise in the handling of capital expenditure projects to the global exploitation of innovations.

Bayer Innovation develops new businesses adjacent to core activities

BAYER INNOVATION

Bayer Innovation investigates and evaluates innovative areas adjacent to the subgroups' current core activities and develops them into viable new businesses for the Group. An example is the manufacture of plant-made pharmaceuticals. In 2010 a Phase I clinical study was launched with a personalized cancer vaccine to treat non-Hodgkin's lymphoma. In the agriculture sector, novel hybrid concepts based on the combination of polymer technologies and crop protection products are under development. The full potential of these technologies is being evaluated in close cooperation with the subgroups and external partners.

TRIPLE-I: INSPIRATION, IDEAS, INNOVATION

The innovation campaign entitled “Triple i: Inspiration, Ideas, Innovation” motivates Bayer employees worldwide to submit ideas for new products and thereby add to the company's innovative capability. More than 11,000 ideas have been submitted since the initiative was launched. Several products resulting from employees' ideas have already been successfully commercialized. In 2010, Triple-i focused on two main areas: the “Your Heart” campaign, designed to identify new opportunities in cardiovascular medicine, and the Triple-i-Vietnam campaign, aimed at the development of new applications for MaterialScience products in Vietnam.