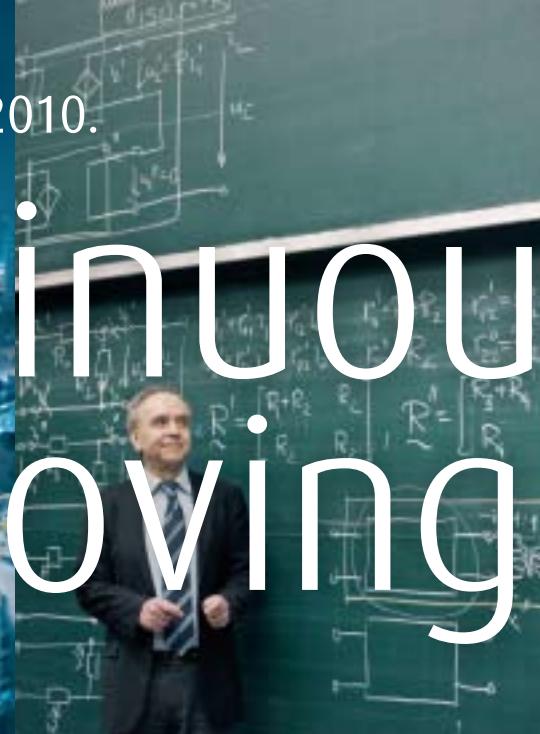
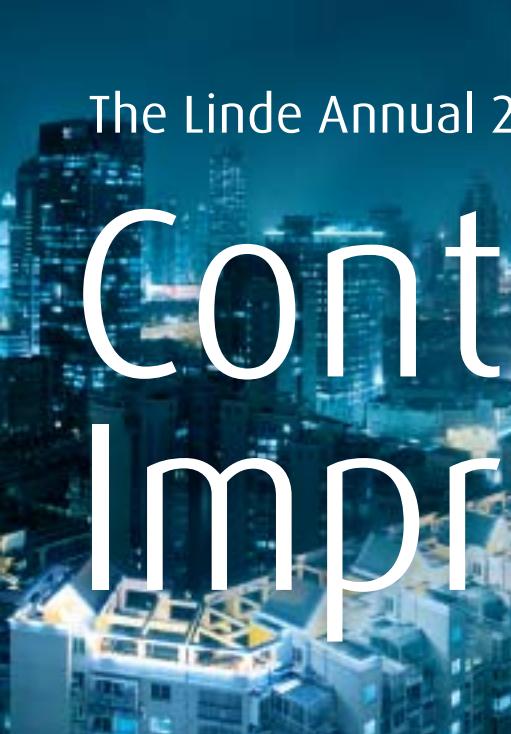


The Linde Annual 2010.

# Continuously Improving.



Leading.



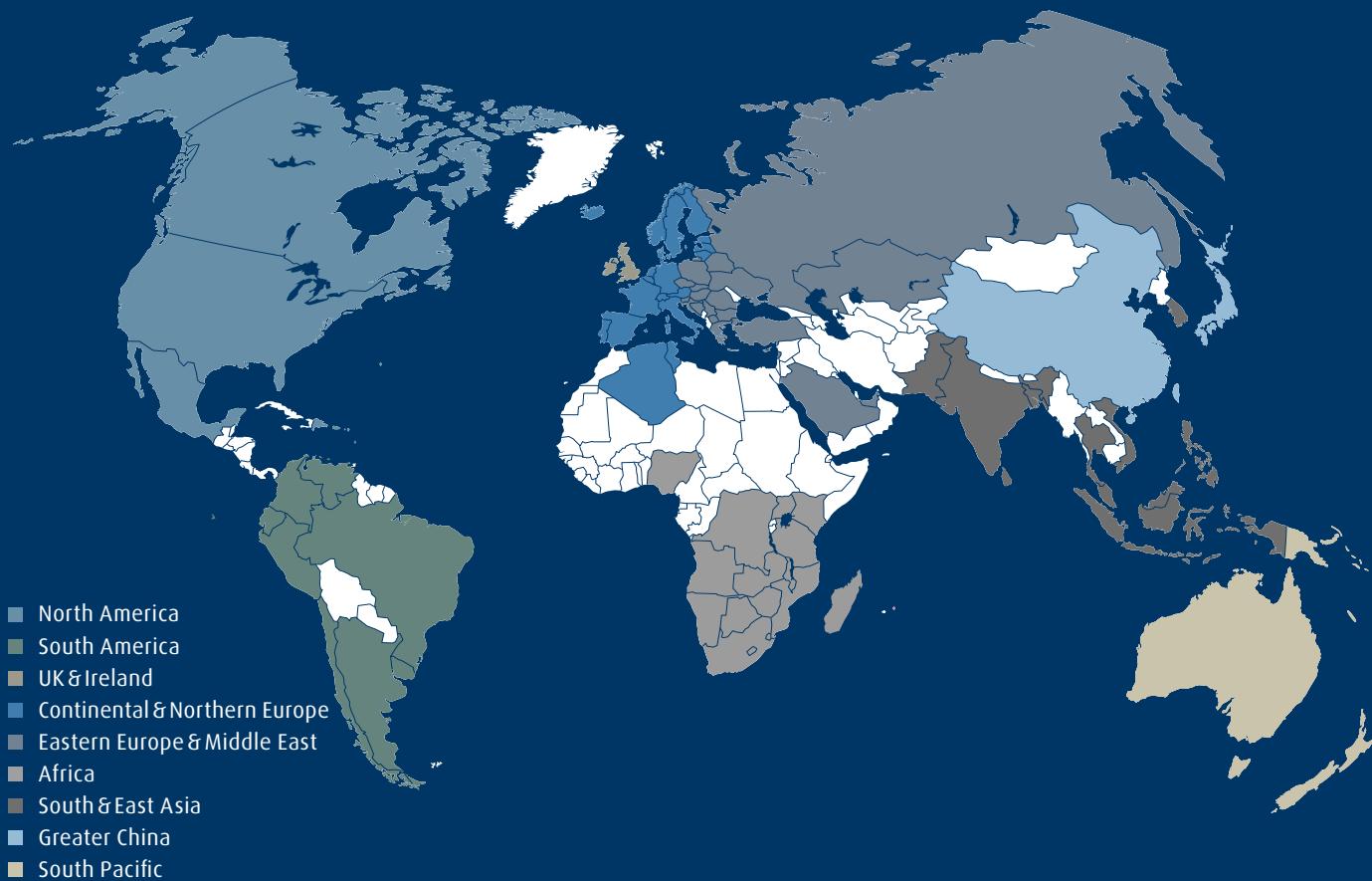
THE LINDE GROUP

## The Linde World

The Gases Division has four operating segments – Western Europe, the Americas, Asia & Eastern Europe, and South Pacific & Africa – which are subdivided into nine Regional Business Units (RBUs). The Gases Division also includes two Global Business Units (GBUs) – Healthcare (medical gases) and Tonnage (on-site) – and two Business Areas (BAs) –

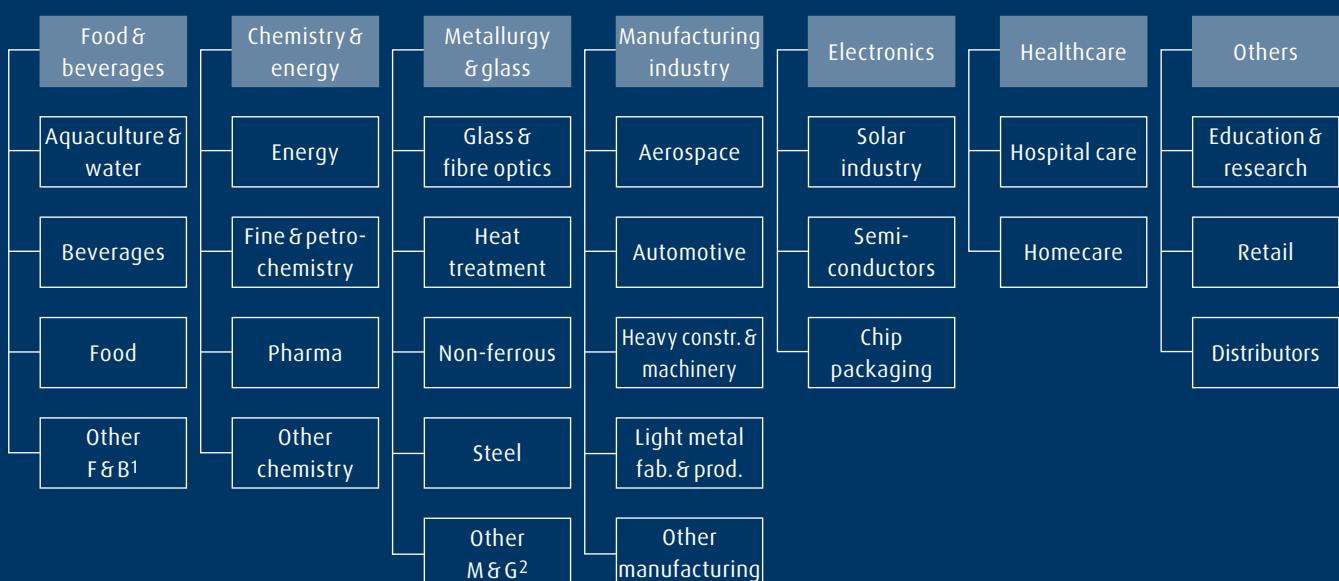
Merchant & Packaged Gases (liquefied and cylinder gases) and Electronics (electronic gases).

Specialised in olefin, natural gas, air separation, hydrogen and synthesis gas plants, our Engineering Division has a global footprint.



## Customer segmentation within the Gases Division

Broad, well-balanced customer base ensures stability.



<sup>1</sup> F & B: Food & beverages.

<sup>2</sup> M & G: Metallurgy & glass.

## Corporate profile

### The Linde Group

The Linde Group is a world-leading gases and engineering company with approximately 48,500 employees working in more than 100 countries worldwide. In the 2010 financial year it achieved sales of EUR 12.868 bn. The strategy of The Linde Group is geared towards long-term profitable growth and focuses on the expansion of its international business with forward-looking products and services. Linde acts responsibly towards its shareholders, business partners, employees, society and the environment – in every one of its business areas, regions and locations across the globe. The company is committed to technologies and products that unite the goals of customer value and sustainable development.

### Organisation

The Group comprises three divisions: Gases and Engineering (the two core divisions) and Gist (logistics services). The largest division, Gases, has four operating segments: Western Europe, the Americas, Asia & Eastern Europe, and South Pacific & Africa, which are subdivided into nine Regional Business Units (RBUs). The Gases Division also includes the two Global Business Units (GBUs) Healthcare (medical gases) and Tonnage (on-site) as well as the two Business Areas (BAs) Merchant & Packaged Gases (liquefied and cylinder gases) and Electronics (electronic gases).

### Gases Division

The Linde Group is a world leader in the international gases market. The company offers a wide range of compressed and liquefied gases as well as chemicals and is the partner of choice across a huge variety of industries. Linde gases are used, for example, in the energy sector, steel production, chemical processing, environmental protection and welding, as well as in food processing, glass production and electronics. The company is also investing in the expansion of its fast-growing Healthcare business, i. e. medical gases, and is a leading global player in the development of environmentally friendly hydrogen technologies.

### Engineering Division

Linde Engineering is successful throughout the world, with its focus on promising market segments such as olefin plants, natural gas plants and air separation plants, as well as hydrogen and synthesis gas plants. In contrast to virtually all competitors, the company can rely on its own extensive process engineering know-how in the planning, project development and construction of turnkey industrial plants. Linde plants are used in a wide variety of fields: in the petrochemical and chemical industries, in refineries and fertiliser plants, to recover air gases, to produce hydrogen and synthesis gases, to treat natural gas and in the pharmaceutical industry.

## Linde financial highlights

in € million

	January to December		
	2010	2009	Change
<b>Share</b>			
Closing price	€ 113.55	84.16	34.9 %
Year high	€ 115.30	87.95	31.1 %
Year low	€ 76.70	49.66	54.5 %
Market capitalisation (at year-end closing price)	19,337	14,215	36.0 %
Adjusted earnings per share <sup>1</sup>	€ 6.89	4.58	50.4 %
Earnings per share – undiluted	€ 5.94	3.51	69.2 %
Number of shares outstanding (in 000s)	170,297	168,907	0.8 %
<b>Sales</b>			
Operating profit <sup>2</sup>	12,868	11,211	14.8 %
Operating margin	2,925	2,385	22.6 %
EBIT before amortisation of fair value adjustments	22.7 %	21.3 %	+140 bp <sup>3</sup>
Earnings after taxes on income	1,933	1,460	32.4 %
Number of employees	1,064	653	62.9 %
	48,430	47,731	1.5 %
<b>Gases Division</b>			
Sales	10,228	8,932	14.5 %
Operating profit	2,766	2,378	16.3 %
Operating margin	27.0 %	26.6 %	+40 bp <sup>3</sup>
<b>Engineering Division</b>			
Sales	2,461	2,311	6.5 %
Operating profit	271	210	29.0 %
Operating margin	11.0 %	9.1 %	+190 bp <sup>3</sup>

<sup>1</sup> Adjusted for the effects of the purchase price allocation.

<sup>2</sup> EBITDA including share of income from associates and joint ventures.

<sup>3</sup> Basis points.

## Our company values

*Passion to excel.*

*Innovating for customers.*

*Empowering people.*

*Thriving through diversity.*

## Our vision

*We will be the leading global gases and engineering company, admired for our people, who provide innovative solutions that make a difference to the world.*



# Continuously improving.

The world needs answers. The way we live and work is constantly changing. Global issues such as climate change, rising energy needs and demographic shifts call for solutions. And international companies can help. Which is why our 2010 Annual asks how an innovative technology player such as Linde can help master the challenges facing society today and generate sustainable value as a company. And although the answers are as diverse and varied as the people we interviewed, they all have one thing in common – they inspire us all to improve continuously.

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→ Commercial hub within a flourishing nation –  
Kolkata (India).

**1. Employees**

## “What inspires us to give our very best?”

For some, it is the challenge of a major international project. For others, the knowledge that they can make a difference. The important thing is that everyone pulls together to build a successful future.



## "Our customers must be able to rely on us."

Moloy Banerjee, responsible for Linde's gases business in India, and Andrew Mole, project manager at Linde Engineering, explain how major international projects depend on tightly coordinated, Group-wide collaboration across national borders.

Linde is currently constructing India's largest air separation unit (ASU) in Jamshedpur, for a long-term gas supply contract with Tata Steel. Clearly a challenging project, so what are the key success factors? And, in concrete terms, how are you tackling this project?

↳ Banerjee: We – and in this case that means our colleagues here in India, colleagues from the Gases and Engineering divisions in Germany and our customer at Tata – first asked ourselves: "What is the most reliable and cost-effective way for us to supply the necessary gases to the Tata steelworks?" Finally, we decided on an end-to-end concept where we acquired Tata's existing plants and are adding more capacity to these facilities. This integration of existing assets with a new plant allowed us to unlock significant value which was vital to our winning this contract.

↳ Mole: Even during that initial phase, our engineers were already on hand to support the project leads, Moloy Banerjee and Joe Dunn. Given the size of this project, we needed to be sure that we got every single step right – from the initial clarification of Tata's requirements to selecting the technology, through costing, scheduling and coordination. Tata is an important and long-standing customer and must be able to rely on us. It's our job to make sure they can. →

↳ Linde at work – constructing India's largest air separation plant in Jamshedpur.





↳ Moloy Banerjee, responsible for Linde's gases business in India.

↳ Andrew Mole, project manager at Linde Engineering, coordinates collaboration between engineering experts and gases specialists.





**Mr Mole, you are coordinating collaboration between engineering and gases experts. Were there any specific factors you had to consider with this ASU project in Jamshedpur?**

↳ **Mole:** Well, one key aspect was that we needed to collaborate very closely with BOC India's Project Engineering Division to maximise the local content of the project, resulting in approximately 50 percent of the contract value being local.

**And does that agreement make life more difficult?**

↳ **Mole:** No, quite the opposite actually. No-one is better placed to understand our customer's requirements than our colleagues on the ground in India, and some of the components for this project would, in any case, be far too large to transport. A real challenge, though, was aligning our Group-wide standards for large air separation units, as defined in the LINEX™ concept (see glossary), with Tata's individual requirements – especially within a tight bidding period. It's rather like a relay race – you have to move quickly but still hand over the baton without dropping it.

**How does collaboration within and across Group divisions work in practice? For instance between engineering experts in Germany and India?**

↳ **Mole:** The collaboration has run very smoothly – and continues to do so. One factor, of course, is that Linde and BOC India – a Linde Group company – have a shared past in plant engineering. We have worked in partnership to engineer and build 14 other plants prior to this current project, and that experience is helping us now in Jamshedpur. Here, more than ever, it is crucial to ensure a highly detailed and tightly coordinated planning process, as well as seamless know-how transfer.

**And how do you achieve that?**

↳ **Mole:** By keeping the communication channels wide open. Even before the project officially started, we met many times in Munich to prevent any gaps in scope and to avoid overlapping tasks. I had also visited our Indian office three times, while Indian engineers have been making regular trips to Schalchen in Germany as well as to our Chinese subsidiary in Dalian to coordinate and exchange technology with Linde colleagues there. To go back to our relay metaphor, these well organised processes, built on a foundation of mutual trust, have ensured a smooth handover of the baton at the end of every lap. →

→ The new air separation plant – a reference project for the whole South-East Asia region.

↳ Teamwork at its best – Linde site staff  
in Jamshedpur.





Mr Banerjee, BOC India has maintained a close business relationship with Tata for many years now. Has this proved helpful in gaining the Jamshedpur contract?

↳ Banerjee: Yes, definitely. The business links between BOC India and Tata Steel go back almost 50 years. Then at the start of the eighties, BOC delivered two air separation units for captive operation by Tata. More recently in 1997, BOC India secured the country's first long-term gas supply contract with Tata and constructed its own ASU to supply the Tata steelworks in Jamshedpur. So we thought we might be in with a good chance when Tata called for tenders in 2007 to expand its gas supplies at the same site. And, as it turns out, our end-to-end offering did indeed clinch the deal in our favour further strengthening our relations with Tata.

**What significance does this Indian project hold for Linde?**

↳ Banerjee: The ASU in Jamshedpur is not only a reference project for India but for the whole South-East Asia region. It gives us the opportunity to prove how well our teams in Germany and Asia can collaborate and break out the tasks involved in such a project. It also demonstrates that standardising certain processes and components, even for major plants, can yield significant cost and time advantages to the benefit of our customers.

# "I can really make a difference."

As part of the Corporate Strategy function, Sapna Sood is involved in implementing Linde's holistic efficiency programme. Here she reveals what she really appreciates about Linde's corporate culture.

In a global group such as Linde, international careers are no rarity. It is fair to say, though, that not everyone is quite as well travelled as you ...

↪ Well, yes, you have a point. My role at Linde has already spanned four continents, with stints in Australia, the US and Singapore and now my current position in Germany.

## And how did you arrive at such a varied path?

↪ The main thing was that the company always offered me opportunities in addition to my regular day job, which allowed me to develop myself further. After my engineering studies, I joined BOC, now part of The Linde Group, in Australia and was immediately part of a graduate programme that focused on talent development. Later on, I gained a lot from our Global Leadership Development Circle (GLDC) – a programme aimed at up-and-coming senior managers.

## What did that offer you?

↪ The GLDC was both challenging and inspiring. We had to put our skills to the test by working on a real business issue and presenting the results to the Executive Board. That was certainly demanding, particularly as the assignments were usually drawn from outside our own areas of expertise. For the GLDC, Linde collaborated with Oxford University through a residential programme. This included some unusual and interesting sessions on strategy, finance and leadership. We were able to take our lead from Leonardo da Vinci for creativity and innovation, for example. →



**How many colleagues took part in the programme?**

↳ At that point there were around forty of us, drawn from all over the Linde world. Being part of this international group was a great experience for me. I also found it a real privilege that all the Executive Board members gave us so much of their time – the channels of communication were really open.

**What motivates you to perform at your best?**

↳ First of all, I have to say that I find the world of gases simply fascinating. The sheer variety of possible applications gives you an insight into such a wide range of markets, industries, processes and product portfolios. I am also motivated by the culture of dynamic performance and achievement – coupled with fair acknowledgement – that I've experienced at Linde. No matter where I have worked for the company or in what capacity, I have always been aware that I can really make a difference. I can contribute to the never-ending quest for even better processes and solutions.



↳ The international flair so characteristic of Linde's corporate culture.

# Competent and committed.

Skilled and motivated employees are crucial to the success of any company. Linde offers its people challenging roles in an international environment, complemented by carefully crafted programmes for personal and professional development. These are tailored to each individual's skills and potential, as well as their specific position in the company, enabling each and every employee to make an active contribution to the success of the company as a whole.



↳ Detailed consultation on site – key success factor for any major project.

T

## The proof is in the projects

A dynamic combination of professional expertise, practical experience, intercultural insights, and collaboration and leadership skills is essential to the success of any project. And nowhere is this more evident than in designing and engineering large-scale industrial plants.

This not only entails developing the right technologies to meet customer-specific requirements and ensuring materials, components and units are procured on schedule. Equally important is the need to carefully coordinate numerous partners and vendors, manage the logistics chain and plan personnel resources right through to going on stream. This requires close and seamless collaboration between all the teams involved – across both organisational and national borders.

Linde is currently engaged in two ambitious projects that are excellent examples of how such challenges can be mastered. These involve constructing a major air separation unit in Jamshedpur, India (see interview, page 06) and completing the world's largest air separation complex (Pearl GTL) in Qatar, engineered by Linde on behalf of Shell GTL Ltd. The eight

plants in this complex will commence operations during 2011, with a total output of 860,000 cubic metres of oxygen per hour. The oxygen is required to turn natural gas to liquid fuel (gas-to-liquids, GTL; see glossary).

## An international path

As commercial manager for Linde, Ralf Forster is supervising the Pearl GTL project on the ground in Qatar. His role not only involves managing finances with the building contractor, but also overseeing the work scheduled at this huge site in Ras Laffan Industrial City. No small task, since in addition to around 190 Linde employees from a whole range of different countries, it means coordinating up to 4,000 workers, engineers and other specialists at any one time. "This is about mastering a real challenge and making an important contribution to our company," says Forster.

Close communication with the relevant departments at Linde's engineering headquarters in Germany is an important part of Forster's job. "Regular discussions and close collaboration are essential to the smooth execution of the project." However, Forster prefers to be in the thick of things: "When you watch an air separation unit come together, reinforcing our reputation as a reliable partner once again, you can't help but feel proud."

After 21 years at Linde, international assignments are nothing new for Forster. In the late nineties, he supervised a project in South Africa before moving on to Abu Dhabi for the assembly of an ethylene plant. His next overseas role was unusual in many ways – overseeing construction of Europe's largest natural gas liquefaction plant on Melkøya Island, off Hammerfest on the northern coast of Norway. Here, too, Forster dealt with the contractual details, organising the deployment of up to 3,500 specialist staff and assembly fitters, accommodation included. At peak times, this included 210 Linde employees and around 100 experts from contracting company Statoil.

"For me, the interesting thing in Hammerfest was having to adapt to the different customs and habits of up to 64 nationalities," Forster recalls. "But that is actually what I enjoy most – working with colleagues from opposite ends of the globe." Since Forster took up his role in Qatar, Claudia Gebert has been representing the company on the Hammerfest project – and the two remain in close contact to share their experiences.



↳ (top) The world's largest air separation complex in Qatar – engineered by Linde.

↳ (bottom) Ralf Forster supervising construction of Europe's largest natural gas liquefaction plant in Hammerfest (northern Norway).

## Know-how transfer in tandem

For a technology player like Linde, it is important to ensure that the knowledge gained by employees over the years is anchored within the company. To capture this brainpower, Linde's Engineering Division has developed a know-how transfer and knowledge building system over the last two decades. It centres on a tandem concept in which one experienced and one younger employee team up together to look after a specialist area. That way, long-standing employees pass on their comprehensive knowledge in the course of their daily work, allowing their successors to quickly take on more responsibilities.

Not only do these expert pairs pool their knowledge and experience, they regularly participate in expert conferences. This keeps Linde at the cutting edge of science and technology in all its fields of activity.

## Continuous qualification process – CQP

To ensure the ongoing development of its people in Germany, Linde's Gases Division has introduced a structured, continuous qualification process (CQP) across all its functions within the division. The programme runs over several years and is divided into five different phases. It starts by communicating the overarching strategic aims and describing the various fields of activity. In the next step, participants receive targeted training courses to acquire the knowledge and skills required for their roles. The annual employee review ensures continuity in applying what has been learnt and helps identify areas offering scope for adjustment or improvement. Employees who successfully complete the programme receive a certificate confirming that they are fit for their job.

The CQP programme offers many advantages both to individual employees and to the company as a whole. Standardised job

## Promoting leadership skills

Linde holds the Global Leadership Development Circle (GLDC) once a year, in collaboration with the University of Oxford. The programme runs over a few months and includes three teaching modules, each lasting several days and focusing on corporate strategy, finance and business, and leadership methods. During the intervening weeks, the participants work on concrete assignments drawn from ongoing company operations. These are accomplished alongside their usual roles (see interview on page 12).

The Global Talent Circle (GTC) is aimed at the company's young high-achievers. Here, too, the curriculum is built around strategic thinking, financial management, business acumen and leadership skills.



↳ Hardwiring knowledge and experience into the company by transferring know-how.



↳ Success through teamwork – employees chat at the Jundiaí cylinder plant in São Paulo (Brazil).

descriptions help to harmonise business processes, which in turn simplifies the integration of Linde Group members. Employees also benefit from the objective and transparent evaluation of their individual performance. Plus the certificates substantiate individual qualifications – both internally and in dealing with customers. Finally, the programme opens up further development opportunities within the company for particularly talented staff.

### Linde University – coaching tomorrow's leaders

Under the umbrella of Linde University, the Group has established an international training and talent management framework for leadership skills. Linde currently offers three Group-wide programmes aimed at different management levels: the Global Leadership Programme (senior executives), the Global Leadership Development Circle (middle management), and a Talent Circle at global and regional level (future leaders). Each of these offer a mixed curriculum of classroom-based and virtual, interactive learning programmes and projects.

Here Linde partners with leading business schools around the world and actively involves senior management to create learning experiences of lasting practical value.

The hallmark of all Linde University programmes is their international and interdisciplinary slant. This attracts participants from different areas throughout the company, creating an ideal informal networking platform across The Linde Group.

### Driving innovation

Since 2006, Linde has been fostering the pioneering spirit and creative talent of its employees with its Patent & Innovation Awards. Each year, these are presented for the best new developments in three categories: "technological innovations", "commercial innovations" and "business innovations". In 2010, nine outstanding patents were rewarded under this scheme. The Linde Innovators Club now numbers over 100 members.

To protect its innovations, Linde filed 232 new patent applications last year across the Group. This brings the number of patents protecting Linde technologies up to 2,788 in total.

# Spotlight.

## Customers the world over rely on Linde's expertise.

Linde Engineering projects by region. New orders 2008–2010 worth EUR 10 m or more.



## Strong sense of commitment to Linde.

Average number of years that Linde Group employees stay with the company compared with national/regional averages.



Source: Linde AG, 2010. Other Sources: Eurostat; BLS, News Release, "Employer Tenure in 2010".

# 30 %

## 17 %

## 16 %

## 11 %

## 11 %

## 9 %

## 5 %

**ASIA:** Benxi (CHN) · Changwu (CHN) · Chah Pan (CHN) · Ningdong (CHN) · Erdos Yankuang (CHN) · Laiwu (CHN) · Wujing (CHN) · Nanjing (CHN) · Taiyuan (CHN) · Jimunai (CHN) · Urumqi (CHN) · Zhang Jia Gang (CHN) · Jamshedpur (IND) · Taloja (IND) · Orissa (IND) · Rourkela (IND) · Mumbai (IND) · Barauni (IND) · Hospet (IND) · Duburi (IND) · Dahej (IND) · Hwasung (KOR) · Ulsan (KOR) · Pasir Gudang (MYS) · Kaohsiung (TWN) · Taichung (TWN) · Temirtau (KAZ)

**WEST EUROPE:** Leuna (DEU) · Nünchritz (DEU) · Duisburg (DEU) · Schwedt (DEU) · Bernburg (DEU) · Motherwell (GBR) · Scunthorpe (GBR) · Milazzo (ITA) · Piombino (ITA) · Hammerfest (NOR) · Sines (prt) · Sagunto (ESP) · Cartagena (ESP) · Nynäshamn (SWE) · Basel (CHE)

**MIDDLE EAST:** Haifa (ISR) · Ras Laffan (QAT) · Al-Jubail (SAU) · Abu Dhabi (ARE) · Ruwais (ARE) · Mirfa (ARE)

**AFRICA:** Reghaia (DZA) · Sukhna (EGY) · Helwan (EGY) · Suez (EGY) · Pretoria (ZAF) · Secunda (ZAF) · Sasolburg (ZAF)

**AMERICAS:** McMurray (CAN) · Poza Rica (MEX) · Mount Vernon (USA) · Houston (USA) · Deer Park (USA) · Garden Creek (USA) · Tulsa (USA) · Resende (BRA) · Puerto La Cruz (VEN) · El Tablazo (VEN)

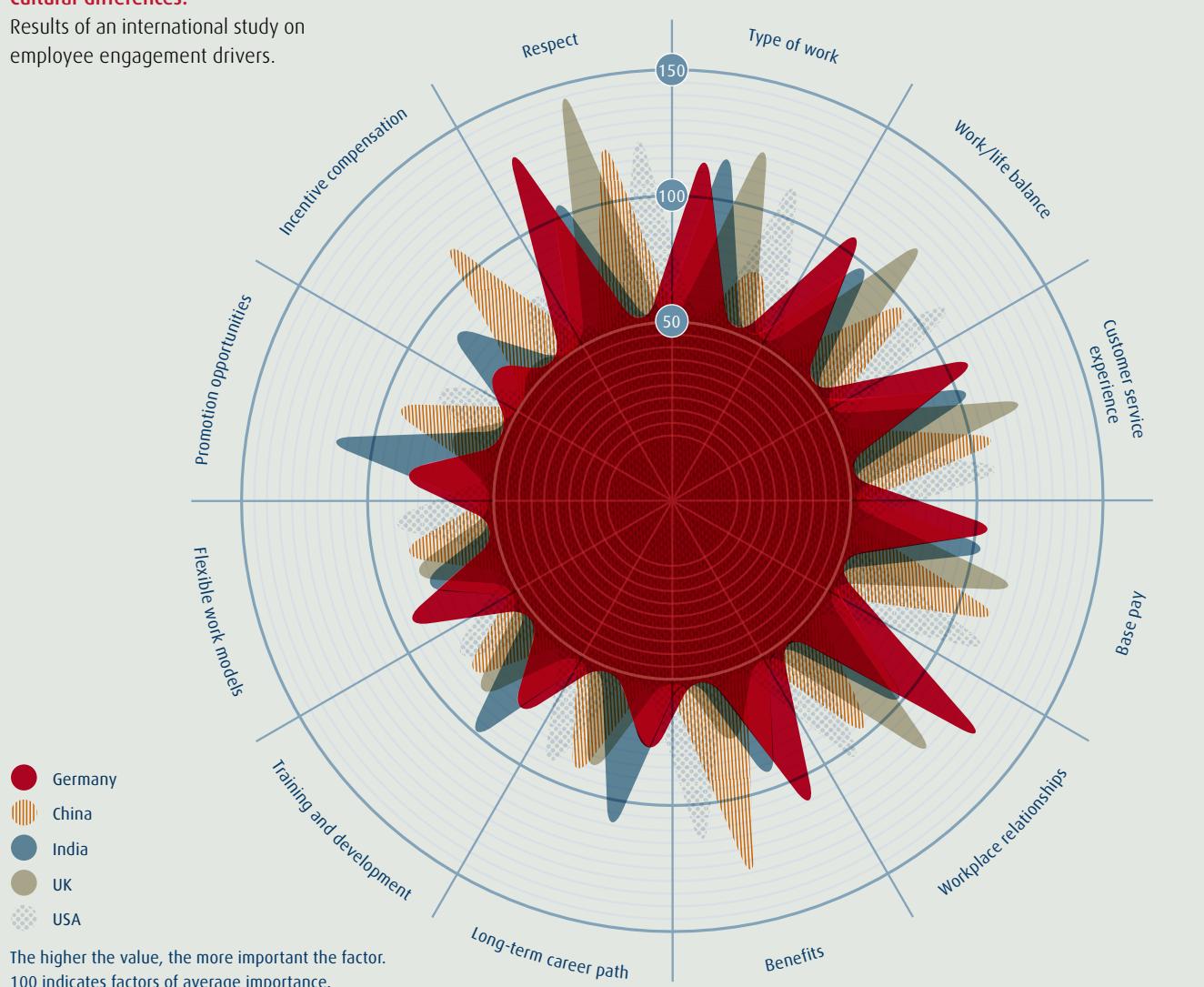
**EAST EUROPE:** Kazincbarcika (HUN) · Galati (ROU) · Constanta (ROU) · Moscow (RUS) · Vorsino (RUS) · Novy Urengoy (RUS) · Novokuibyshevsk (RUS) · Tobolsk (RUS) · Yekaterinburg (RUS)

**OCEANIA:** Gladstone (AUS) · Dandenong (AUS) · Karratha (AUS)

Source: Linde AG, 2010.

### Cultural differences.

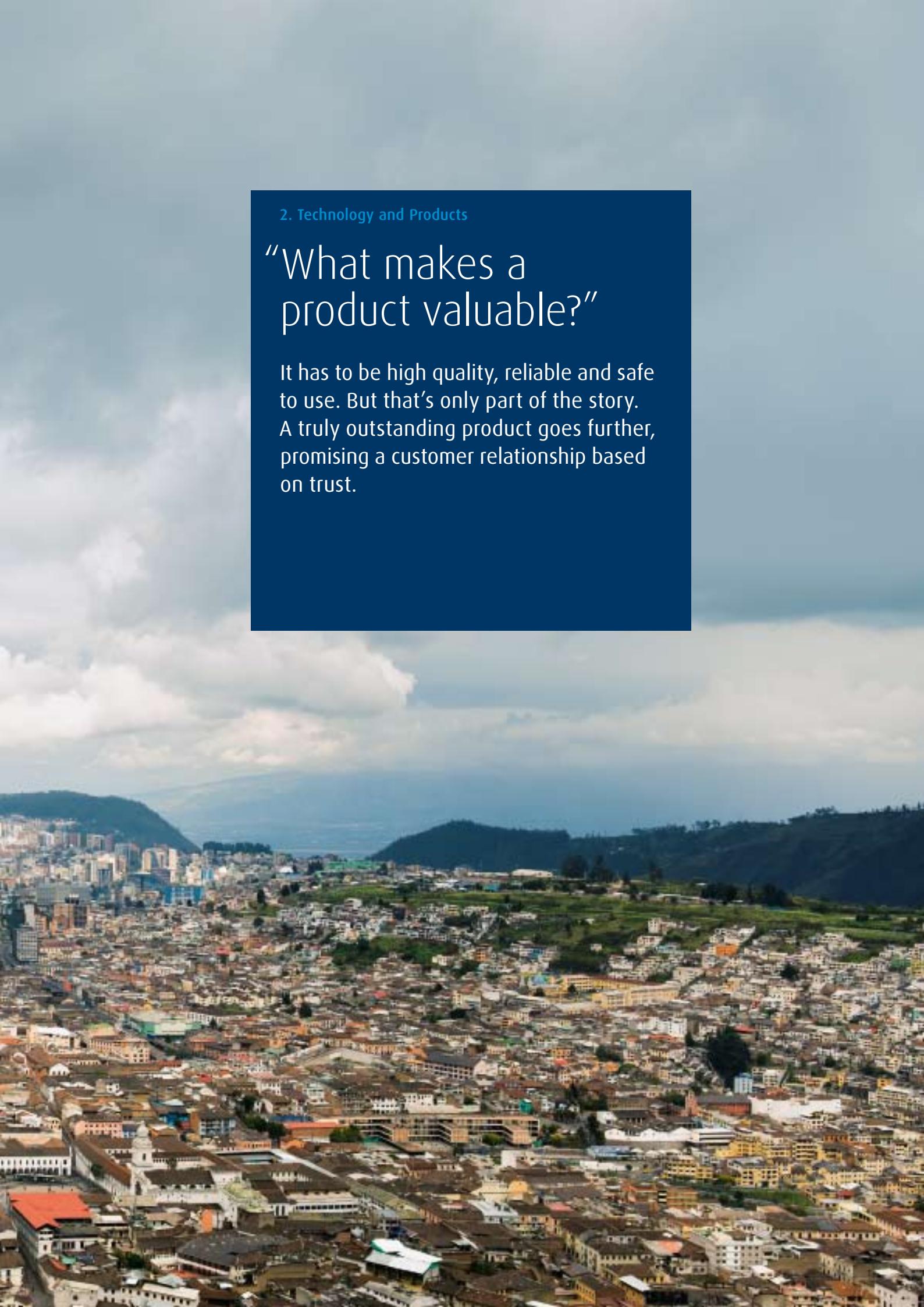
Results of an international study on employee engagement drivers.



Source: Mercer Study "Engaging employees to drive global business success", 2007.

↳ South American growth markets –  
Quito (Ecuador).



The background of the entire image is a wide-angle aerial photograph of a city, likely Quito, Ecuador. The city is built on a hillside, with numerous buildings of various colors and sizes. In the distance, there are green hills and mountains. The sky above is filled with white and grey clouds.

## 2. Technology and Products

# “What makes a product valuable?”

It has to be high quality, reliable and safe to use. But that's only part of the story. A truly outstanding product goes further, promising a customer relationship based on trust.

# "Linde is a partner, not just a supplier."

Dr Francisco López is head of the Clínica Pichincha in Quito, Ecuador, and a long-standing Linde customer. Here he discusses his expectations of a medical gases provider.

Dr López, your hospital relies on Linde's products and services for its medical gas supplies. What do you expect of your suppliers?

↪ We doctors must be certain that the medical gases we use to treat our patients are of the highest quality and purity. When it comes to people's lives, we cannot compromise or settle for second best. And that applies equally to the technical equipment we use to supply gases to our patients.

So it's a question of trust?

↪ Yes, absolutely. And that trust takes years to develop. I have been working together with Linde – or AGA, which joined The Linde Group some time ago – for 25 years now. And in that time, I have only ever had positive experiences. Linde gives us both safety and reliability. →





↳ Clínica Pichincha – a high-tech hospital located in central Quito.

**And does the same go for consulting and services?**

↳ Now, that is another important point. In emergencies, there cannot be any delays, shortfalls or other mishaps – we need skilled experts on hand immediately. That is the only way we can give our patients the best possible care.

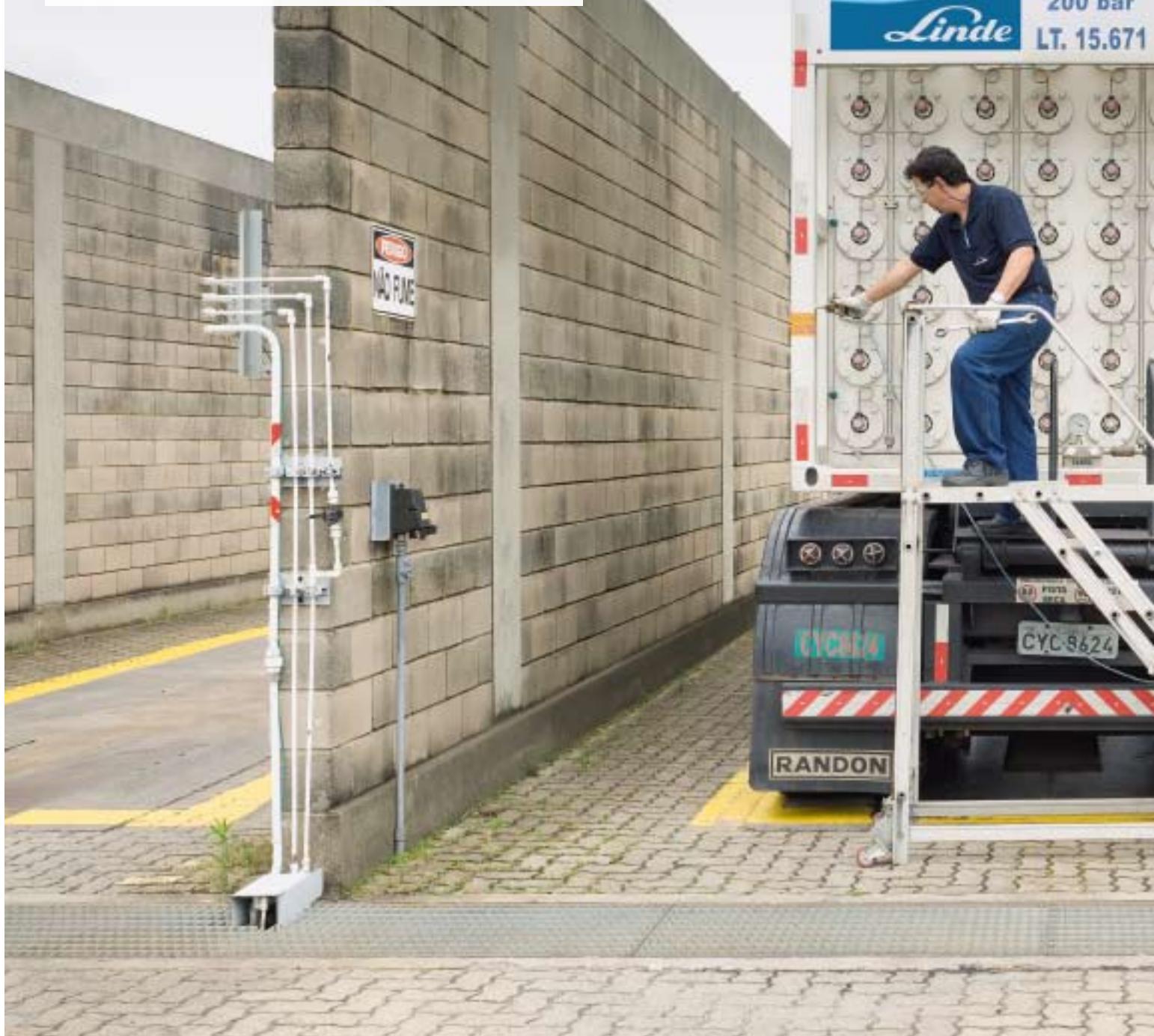
And I am pleased to say, this works extremely well with Linde. We see Linde as a partner, not just a supplier.

**What sets this partnership apart?**

↳ We have contacts at Linde who are available straight away when we need them and are able to give advice that helps us and our patients. They put themselves in our shoes, take responsibility and place safety above all else.

**Sounds like a partnership with a future ...?**

↳ Yes, we have every intention of continuing this successful collaboration. Indeed, a short time ago, we set up a new operating theatre in our hospital. Linde provided us with state-of-the-art application technologies to supply the medical gases and is also looking after maintenance. We are very happy with the service from Linde.



↳ Safety is a top priority – and not just for medical gases. A safe, reliable supply is also essential for other gases such as hydrogen – as shown here in Brazil.





↳ (right) Gases are indispensable in a wide range of automotive production processes, such as in innovative welding techniques.

# "Much more than just molecules."

As Head of Global Process Industries, Volker Häckh drives the company's research and development activities worldwide. Here he describes how the company goes about identifying and developing new market opportunities.

**Mr Häckh, how do you turn elements of the atmosphere such as oxygen, nitrogen or hydrogen into marketable products?**

↪ That all depends on what use you put these gases to. We are not just marketing molecules here. We analyse the processes involved in manufacturing and treating a wide range of materials, from steel, glass and aluminium right through to foodstuffs or oil in refineries. And then we develop gas-enabled applications that enable our customers to increase process efficiency, product quality and overall profitability. With each new application scenario, we open up new market opportunities. It's not about ploughing money into new technologies – it's all about brainpower.

**How do you ensure that your ideas really target future trends?**

↪ We focus on the global megatrends relevant to our company. In other words, mainly energy, the environment and healthcare. Beyond that, we also keep an eye on current developments in the food and beverages industry, for instance. Here, consumers are increasingly leaning towards convenience products that can be quickly and easily prepared. →



↳ Linde runs its own research and development centres in the world's dynamic regions, such as here in China.



#### How does focusing your R&D activities benefit your customers?

↳ It allows us to zone right in on our customers' individual needs and develop solutions that directly answer those challenges. Close collaboration is essential here – with our Gases Division colleagues in the various regions, but also with our engineering experts and especially with our customers themselves.

#### Can you give us a better idea of what this collaboration entails?

↳ Let's say we recommend that a steel company implements our REBOX® technology together with an ECOVAR® system (see glossary). Our engineers would then work with that customer to develop the right application technology. This detailed know-how transfer is crucial because we are diving deep into the customer's processes with that technology. So it is also a question of trust. →



#### **And how do you cultivate that trust?**

↳ Through the quality of our work, which adds real value to our customers. They stand to gain, for instance, when we alert them to future market trends and recommend new technologies and processes.

#### **Such as ...?**

↳ Well, take hot-forming, currently growing in popularity in the automotive industry. Applying heat allows a bodywork component to be easily shaped and results in greater ductility. The B-pillar of a car, for instance, needs to have different properties in different places. It must be able to absorb deformation energy at one point while remaining particularly rigid at another. That is now accomplished directly in the moulding press through different annealing states and material bonds.

#### **Where do the gases come in?**

↳ The gases are required for heating. The component must be heated to different extents depending on the intended properties. We train the flame directly on specific areas of the component and heat each of them to the required temperature.

#### **What are the hottest new trends in application technology at the moment?**

↳ New, highly efficient materials are gaining in importance. For instance, we are currently working on a particularly thin and cost-effective glass for solar panels. Meanwhile, in another project, we have developed a method that makes the surface of steel more porous, thus enlarging it.

#### **What are the advantages of that?**

↳ The larger surface area can conduct heat better, for example. And this particular surface treatment method could open up new application areas in medicine, too, which our healthcare colleagues are now investigating.

#### **So application technology provides momentum for the Group as a whole?**

↳ Yes, that is how we see our role. Maintaining our innovative lead is essential to keep us ahead of the competition. So we will continue to capitalise on our application technology know-how, increasingly also in the emerging Asian markets.

↳ Special gases from Linde enable environmentally friendly production of solar modules.

# Trust inspired by quality.

At Linde, quality, safety and reliability are the defining criteria for all our products, technologies and services. They lay the foundation for the relationships of trust that we build with our customers – and are thus key success factors across all lines of business.

## E

### Extensive gas portfolio for hospitals

Nowhere is meeting these criteria more vital than in the medical gases business. Medical gases play a major role in diagnosing and treating many illnesses. Every day, they prove invaluable across a wide range of treatments and therapies extending from surgery through emergency services to intensive care. All these applications call for consistently high quality standards – and not just in relation to the purity of the actual gases. All links in the gas, technical equipment and services chain must dovetail seamlessly to ensure the best possible support for doctors and medical staff.

One of the tools offered by Linde to meet these challenging requirements is its QI Medical Gas Services (QI stands for “quality improvement”). Tailored to the needs of hospitals, this offering spans the entire medical gas supply system. Practical services range from planning gas delivery concepts through ensuring emergency supplies to managing maintenance and repairs. Ongoing monitoring and staff training are also available.

### Testing times for medical gases

The quality benchmarks for medical gases are constantly on the rise. In many countries, these products are subject to the same stringent regulations as other pharmaceuticals. The Brazilian health authority, ANVISA, issued an ordinance to this effect in 2009, for instance.

Linde is now in the process of aligning its systems and filling stations with the new regulations in this region. Scheduled for completion by the end of 2011, these measures entail investments of EUR 6 m. From 2015 onwards, the new regulations stipulate that only companies whose facilities are certified to the new standards will receive permission to supply medical gases in Brazil.

### REMO® goes from strength to strength

Linde further expanded its REMEO® care concept in Columbia during the reporting year, opening a second facility for long-term ventilated patients. The REMEO® centres unite peace of mind on the medical front with greater comfort for the patient. They shorten the time spent in hospital intensive care units and offer professional treatment in surroundings more similar to home.

The plan is to gradually export this successful model to other South American countries.



↳ A must for any hospital – medical gases and the right technical equipment.

To accelerate set-up and expansion of the necessary infrastructure and ensure service excellence in the centres, Linde held intensive training for staff from the entire South America region in Bogotá (Columbia) last fiscal year.

## R & D: Spotlight on megatrends

In the industrial gases segment, Linde focuses on continuous improvement of existing application technologies on the one hand, and new application opportunities on the other. The company's research and development activities revolve around six key megatrends: reduced environmental impact, industrial process efficiency, clean energy, healthy eating and convenience food, geographic and demographic shifts, and performance materials.

Against this backdrop, Linde has reviewed all ongoing projects in the liquid and cylinder gases segment and reshuffled its R & D portfolio accordingly. The company's top priorities remain added value for customers, greater cost efficiencies and a consolidated position as preferred partner in emerging economies.

## Welding process enhancements

In metal fabrication, Linde's current activities include driving further improvements to welding processes. Teaming up with other respected industrial enterprises and research institutes, the company is participating in the British R & D project MALCO (Creating Opportunities for the Manufacture of Lightweight Components), set to run over several years. This project aims to reduce strains and prevent distortion when welding metal components for lightweight designs.

As part of their research efforts, the development partners tested a new welding process during the last year and brought it to industrial-scale maturity. The pioneering system for welding thin sheets harnesses carbon dioxide ( $\text{CO}_2$ ) cooling technology from Linde to solve the problem of materials warping due to heat. This is an important success factor in the automotive industry, for instance, since using lighter materials reduces vehicle weight and thus contributes to lowering fuel consumption and emissions.

Flame straightening is another method of correcting welding-induced distortions in thin steel. Linde has accumulated in-depth expertise in this area and actively transfers this bundled know-how within company walls and beyond to the benefit of customers. The company has expanded the welding courses on offer at its Applications Technology Cen-



↳ Linde continues to optimise welding processes with innovative gas applications.

tre in Hamburg and now delivers starter and advanced courses in flame straightening, certified by the German Welding Society (DVS).

## Energy-efficient production with REBOX®

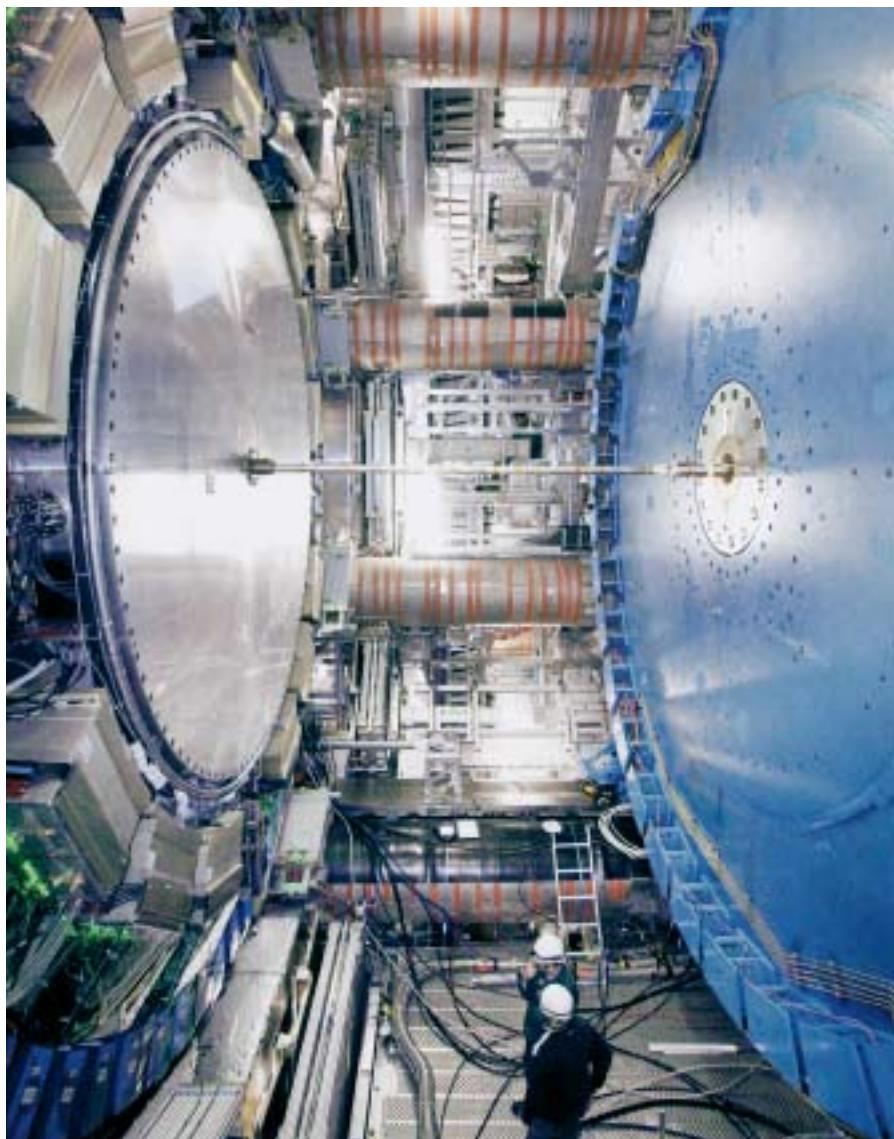
Industrial gases play a major role not only in treating but also in manufacturing steel, significantly influencing the quality, costs and environmental impact of production processes.

Linde's REBOX® oxyfuel system (see glossary) is a particularly effective way of maximising process efficiencies. It uses oxygen instead of air to combust fuel in industrial heating furnaces. This raises the combustion efficiency and distributes the heat more evenly. With this technology, steel manufacturers can significantly cut energy costs and reduce their  $\text{CO}_2$  emissions by 25 to 50 percent.

This innovative solution again scored numerous successes over the past year.

Linde was contracted by Swedish steel manufacturer SSAB to deliver a large-scale REBOX® oxyfuel installation for its steel mill in Borlänge, Sweden. In combination with a smaller system installed at the same facility in 2009, this will represent the world's largest oxyfuel combustion system in any reheating furnace.

At the end of 2010, Linde also signed an agreement with Taiyuan Iron & Steel (TISCO), China, to supply oxygen for future REBOX® applications.



On the trail of the Big Bang – liquid helium cools the magnets which keep protons on course at the European Organisation for Nuclear Research (CERN) near Geneva (Switzerland).

## Enduring customer relationships

As a reliable supplier and an innovator in developing and advancing processes and methods, Linde builds lasting customer relationships that strengthen over decades.

A case in point is ThyssenKrupp. Since 1951, Linde has constructed a total of ten air separation units for the steel manufacturer at its Duisburg (Germany) location, and construction of the eleventh is already underway. This facility is set to go on stream in the third quarter of 2013, at a capacity of up to 1,500 tonnes of oxygen per day. Linde has been responsible for the complete air gas supply at the Duisburg steelworks since 1998. ThyssenKrupp produces almost 15 million tonnes of crude steel there annually, primarily manufacturing high-grade products from quality flat steel for customers in various industries, automotive included.

Another long-standing relationship and commitment to the area exists in Scunthorpe,

UK, where BOC built the first air separation unit more than 50 years ago. Linde's latest project at the UK's largest steel processing centre was a large new air separation facility for Tata with a capacity of 1,600 tonnes of oxygen per day, which opened for operations in autumn 2010. As part of a comprehensive modernisation programme, Linde will also be revamping an older existing facility at the same site.

In the food and beverages sector, too, Linde is committed to maintaining close and lasting customer relationships. This extends far beyond the reliable supply of gases such as carbon dioxide to include value-added advice and support in areas such as environmental protection, quality assurance, innovation and employee training.

Linde's collaboration with world-leading beverage companies also includes water supply and treatment plus plant safety at the bottling facilities, for instance. Linde also works with these customers to define concrete

environmental targets aimed, for example, at energy and water conservation.

## Ready for rise in demand for helium

This noble gas is rare and demand is growing, which means measures must now be put in place to secure future supplies. Linde is stepping up to the helium challenge by expanding its sourcing pool.

In May 2010, Linde signed a long-term gas purchase agreement with the owners of the new Helium 2 plant in Qatar. This will become effective when production begins there in 2013. In conjunction with the existing Helium 1 plant, this latest facility will make Qatar – a kingdom rich in natural gas – the world's leading helium producer. Linde will purchase around 30 percent of the country's total helium output, thus securing future supplies for Linde customers around the globe. The Qatar Helium 2 plant will be the largest of its kind worldwide. The natural gas from which the helium is obtained comes from a reserve estimated at 25 trillion cubic metres, making it the biggest gas field in the world at present.

In addition to these sources in Qatar, Linde ensures a steady supply of helium through the Helison joint venture in Algeria, production facilities in the US and, since March 2010, a new plant in Darwin, Australia. This facility can generate around 4.3 million cubic metres of the gas per year, supplying demand in Australia and New Zealand. Linde also intends to export helium from Darwin to several Asian markets.

Thanks to its unique properties, including a boiling point below  $-268^{\circ}\text{C}$ , helium is used in large quantities in medical technology – for instance as a cooling agent in magnetic resonance imaging (MRI, see glossary) – as well as for lasers and fibre optic cables, in the semiconductor and photovoltaic industries and as a lifting agent for airships and balloons.

## Safety first

Linde's commitment to its customers does not stop with the secure supply of industrial gases. Just as important for Linde is the knowledge that these gases are being delivered and used according to the strictest safety standards. This applies to all its products, processes and plants both within and beyond the company.

To ensure the highest possible standards in this area, Linde reassessed its SHEQ (Safety, Health, Environment, Quality) Group strategy at the start of 2010, setting itself even more ambitious targets.

The company has defined clear targets for plant quality, classification of hazards, licensing and audits, lines of responsibility and qualifications. These also take account of local dynamics and legislation. Risks to employees, local residents and neighbouring companies arising from the operation of Linde's produc-

tion facilities are systematically identified and assessed under the Group-wide Major Hazards Review Programme (MHRP).

At regional level, Linde has implemented further Major Accident Prevention Policies (MAPP) across its global gases business to reduce the likelihood of work-related incidents.

In plant planning and engineering, HSE (Health, Safety, Environment) metrics are an integral part of the specifications. Design reviews play an important role here, with interdisciplinary teams checking that all HSE criteria are met during each individual phase of a plant construction project. Linde also involves its suppliers in these inspections.



↳ Safety starts with the right equipment – Linde employee Sunil Virma at a construction site in Jamshedpur (India).



↳ Refuelling a nitrogen tanker – the right way.

## Linde Group Safety Award

Each year, Linde encourages best practices in occupational safety with the Linde Group Safety Award. This award is presented on the basis of working hours minus lost time injury (LTI) figures reported by the individual Linde sites and companies. There are three separate awards – the Site Safety Award, the Company Safety Award and the Improvement Award for the site or company that made the biggest strides in reducing LTI rates.

# Spotlight.

## LIPROTECT®: handling gases properly

Linde offers an end-to-end safety concept for gas systems operators under the brand name LIPROTECT®. The programme includes training sessions targeted at both technical staff and managers but tailored to the requirements of individual operations. It also comprises a comprehensive portfolio of services related to gas supply, extending from risk analysis through status checks and conformity audits to maintenance. The offering is rounded off by safety accessories such as protective clothing, masks and goggles, including safety gloves for handling cryogenic liquid gases.

Since September 2010, Linde has provided regular training in handling acetylene safely and effectively. Held at the company's gases centre in Unterschleißheim, near Munich, the sessions equip participants with all the basics needed to operate an acetylene plant safely and reliably. Participation in this safety programme also serves as a building block for certification and audits.

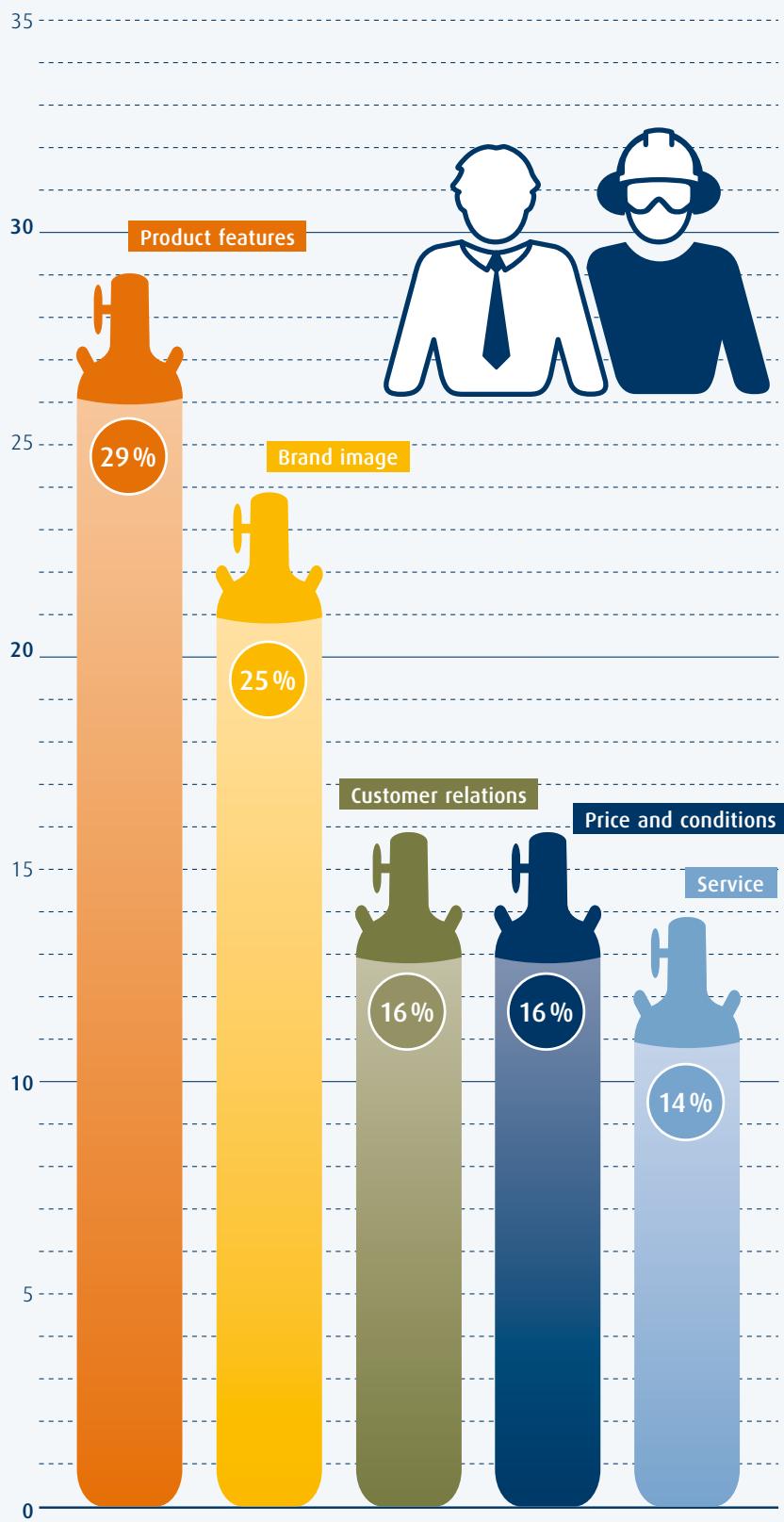
## Forging ahead in the US

Linde's commitment to safety in the US includes sponsoring a safety day for handling industrial gases on the campus of Pennsylvania State University in DuBois, Pennsylvania. The latest event for customers, fire officers and the emergency services took place in July 2010. Safe handling of cryogenic and compressed gases was the focus here.

Linde is also a member and supporter of the American Chemistry Council's Responsibility Care Initiative and has already won numerous safety awards.

### **Brand image and customer relations are key.**

Linde study reveals factors that influence the decision-making process among gases customers.



Source: Linde AG.

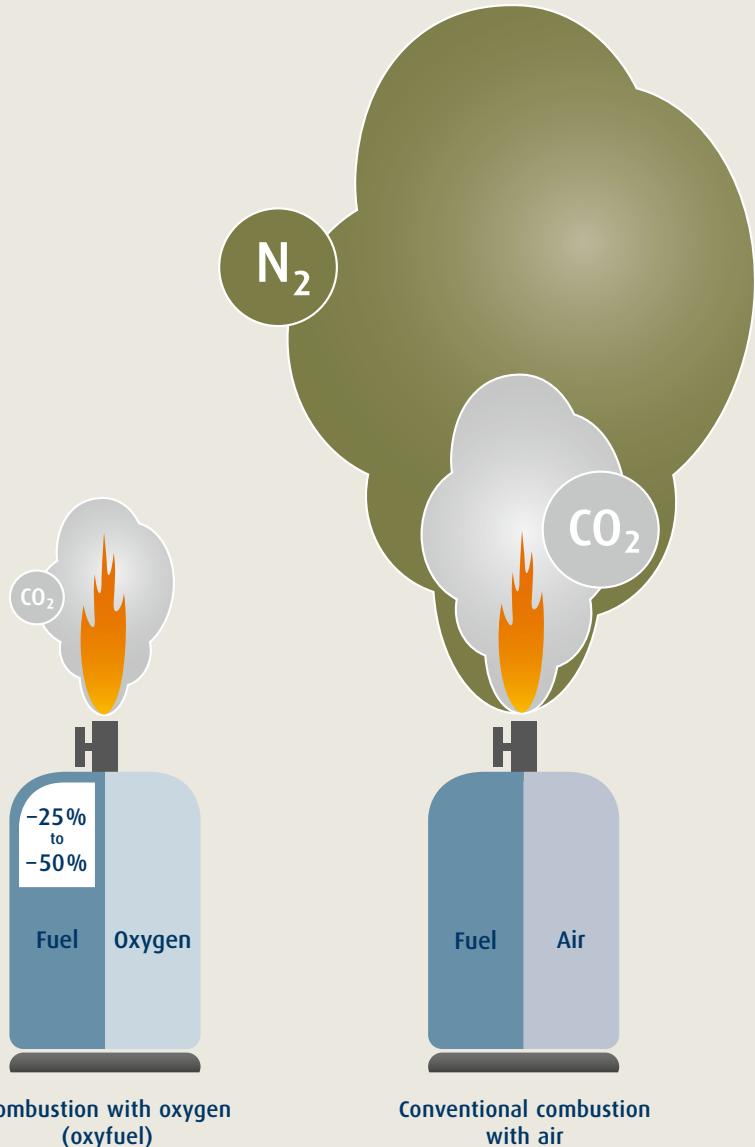
### Clean combustion with oxygen.

Reducing fuel consumption and CO<sub>2</sub> emissions with oxyfuel combustion.

CO<sub>2</sub> emissions  
-25 %  
to  
-50 %

In reheating of semi-finished steel for rolling or forging, a full oxyfuel installation delivers energy efficiency of 80 percent, compared with 40–60 percent with an air/fuel system. This is partly due to the elimination of nitrogen (N<sub>2</sub>) ballast. This translates into potential fuel savings of between 25 and 50 percent.

Source: Linde AG, 2010.



### Safety first – at all times and places.

Number of workplace accidents per million hours worked (Lost Time Injury Rate – LTIR) by employees of The Linde Group.

100 %  
SHEQ



Source: Linde AG, 2010.



A wide-angle photograph of a rugged mountain range under a clear blue sky. In the foreground, two young children wearing traditional Peruvian ponchos (one red, one pink) and hats stand on a dirt path. The mountains behind them are covered in green vegetation and rocky terrain.

### 3. Environment and Resources

“How should we treat the environment and natural resources?”

The global population is expanding and energy requirements are on the rise. Eco-friendly technologies are essential to successfully combat climate change.



↳ Eco-friendly refuelling – Linde's hydrogen centre in Unterschleissheim, near Munich.



## "Opportunities are ours for the taking."

**Dr Andreas Opfermann, Head of Clean Energy & Innovation Management, on Linde's strong footing in the fast-growing energy market.**

Dr Opfermann, energy is now seen as a global megatrend with huge market potential. What opportunities does this open up for Linde? And what challenges need to be tackled?

↳ Energy is undoubtedly a growth market. Experts anticipate that global energy consumption will increase by 30 to 40 percent over the next 20 years. So we have to find reliable ways to meet this demand, while keeping costs competitive and protecting the environment as far as we can. Successfully combating climate change calls for a significant reduction in CO<sub>2</sub> emissions, for a start.

### How can Linde contribute to this?

↳ We have a wide-ranging technology portfolio aimed at reducing the current environmental impact of fossil fuels and reducing CO<sub>2</sub> emissions. We are also driving development of alternative fuels and renewable energy sources. In all these areas, we are able to draw on over 100 years of experience in optimising thermodynamic processes. This know-how is a key success factor in developing many of the emerging technologies. →



**Could you give us a few examples of this technical expertise?**

↳ Our carbon capture, storage and recycling methods are a case in point, as are our processes for enhanced recovery of crude oil and natural gas. We also offer technologies for natural gas liquefaction plants of all sizes. And not forgetting, of course, our pioneering work with hydrogen. We not only use this to desulphurise petrol and diesel but are increasingly tapping its greater potential as a clean energy carrier, for instance as fuel for zero-emission vehicles.

**So this technology portfolio gives Linde a competitive advantage?**

↳ This depth and breadth of our portfolio, extending throughout the entire value chain, is something none of our competitors can match. In all the areas I mentioned above, we not only develop the enabling processes and technologies but also implement them. So we both engineer and operate production facilities.

**And now you want to play even more effectively to your strengths?**

↳ Exactly, which is why we have established the Clean Energy Group at Linde. This acts as a cross-disciplinary platform, bundling and advancing our expertise in energy and sustainability. It provides customers with a one-stop-shop for the combined strengths of our Engineering and Gases Divisions in the clean energy growth market. And with that kind of muscle, opportunities in this fast-growing market are ours for the taking!



↳ Powering growth –  
in Shanghai (China).





## "The hydrogen in Spartanburg is truly green."

Dave Read, one of Linde's Business Development Managers for Alternative Fuels, discusses the merits of hydrogen from sustainable sources.

Linde is supplying hydrogen to fuel the materials handling fleet at BMW's plant in Spartanburg, South Carolina (US). But why did BMW switch from batteries to hydrogen fuel cells (see glossary) in the first place?

→ This is in effect the first time BMW has used hydrogen-powered forklifts trucks in any of its plants. The company is committed to making its production processes as eco-friendly and energy-efficient as possible. Hydrogen offers several benefits over batteries. A driver can refuel a forklift with hydrogen in under three minutes, while batteries take between ten and 20 to change. And, unlike batteries, fuel cells do not lose their power output towards the end of their eight-to-ten-hour window. Instead, performance remains at the same high level throughout the entire shift. Using hydrogen also eliminates costs for environmentally sound disposal of lead-acid batteries. →



↳ Zero emissions – the forklifts at BMW's Spartanburg, US, plant are fuelled by hydrogen.

- Asia is also seeing increased demand for alternative fuel sources – hydrogen refuelling station in Shanghai.



### **How green is the hydrogen used in Spartanburg? How and where is it produced?**

→ The hydrogen used in Spartanburg is truly green. It occurs as a by-product waste stream at a sodium chlorate plant. We then purify, compress and liquefy it using power from a hydroelectric plant, so our electricity also stems from a renewable energy source, resulting in a pure stream of green hydrogen.

### **Linde not only delivers the hydrogen but also sets up the necessary technical equipment and fuelling systems. What is so special about Linde technology?**

→ In a nutshell, BMW trusts Linde technology and expertise. We used a state-of-the-art ionic compressor (see glossary) in the refuelling system. This industry-leading technology has been used extensively for cars and buses in Europe and is now being introduced to the US market. This compressor represents a developmental leap in hydrogen fuelling technology. Compared with conventional technology that our competitors use, it is a high-efficiency, high-throughput, low-maintenance and low-noise compression solution that fuels vehicles quickly and safely.

### **How does Linde compare with its peers in the hydrogen energy arena?**

→ Linde was one of the earliest entrants into the hydrogen energy arena and has decades of experience in the safe production, storage and handling of hydrogen. It is no coincidence that we have already set up over 70 hydrogen fuelling stations worldwide – more than any other company.

### **Fuelling forklifts with hydrogen is not new to Linde either, is it?**

→ No, Linde has already delivered hydrogen refuelling stations for forklift fleets – for instance at the distribution centres run by large retail, drinks and food companies in the US and other countries.





- ↳ Greener than petrol or diesel – a gas tanker leaves Europe's largest LNG plant off Melkøya Island near Hammerfest (Northern Norway).





# Energy and chemistry – without the downsides.

The world's population is growing – as is our need for energy. The challenge is to ensure a reliable supply to meet this increasing demand, while significantly reducing CO<sub>2</sub> emissions. Linde is tackling this head-on with a range of innovative technologies.



## Europe-wide targets

The European Union (EU) has set itself the goal of reducing CO<sub>2</sub> emissions by 20 percent across all member states by 2020. Achieving this calls for joint, concerted action from policy-makers, industry players and society at large. For companies, it means stepping up development of eco-friendly technologies and processes that facilitate sustainable growth, conserve our finite resources and make renewable energy economically viable.

## Committed to climate protection

As a technology player, Linde has declared climate protection to be one of its top priorities:

- Together with partners and customers, Linde develops and tests products and processes aimed at supplying organisations and private households with low-carbon forms of energy.
- Linde provides power plant operators and refineries with technologies that help increase their energy efficiency and reduce or completely eliminate harmful emissions.

- Linde is pioneering the advancement of hydrogen technologies. The company's portfolio covers every step in a functional hydrogen value chain – extending from generation right through to vehicle fuelling. Inspired by a strong sense of responsibility in this area, Linde is working hard to establish a far-reaching fuelling infrastructure for hydrogen-powered fuel-cell vehicles.
- Linde delivers the specialty gases needed for eco-friendly solar cell production.
- Linde works with partners to develop and test methods of producing biofuels from renewable energy sources.

## Spotlight on CO<sub>2</sub>

The switch to a sustainable flow of energy cannot be accomplished overnight. Despite all efforts to develop renewable sources, it is expected that the majority of our energy will continue to stem from fossil fuels until around



↳ Pilot project for purifying, compressing and storing CO<sub>2</sub> – the Vattenfall plant in Schwarze Pumpe, Brandenburg (Germany).

the year 2030. In China alone, a new coal-fired power plant goes online every second day at present.

Linde is a proven technology player for each of the three currently viable methods of minimising CO<sub>2</sub> emissions from existing and future coal-fired plants. These are post-combustion capture, where flue gas is purified of carbon dioxide after combustion; pre-combustion capture, involving upstream separation; and oxyfuel technology, where coal is combusted in an atmosphere consisting of pure oxygen and CO<sub>2</sub>. Water vapour is removed from the resultant flue gas by condensation, leaving a highly concentrated CO<sub>2</sub> stream, which is then purified and compressed prior to storage. This is part of the carbon capture and storage (CCS) process chain.

The Vattenfall energy group is currently working with Linde to test this oxyfuel process in a pilot facility at the Schwarze Pumpe industrial park in Brandenburg (Germany).

*"CCS will prove indispensable in the medium and long term."*

Ottmar Edenhofer, Chief Economist at the Potsdam Institute for Climate Impact Research (PIK) and member of the Intergovernmental Panel on Climate Change (IPCC)

In summer 2010, Linde and Vattenfall also conducted successful trials at the Schwarze Pumpe pilot plant to remove nitrogen and sulphur oxides from power station flue gases. Based on alkaline scrubbing, the LICONOX™ process is now ready for market launch.

Since 2009, RWE has been collaborating with BASF and Linde on a pilot project in Niederaussem, Germany, to separate CO<sub>2</sub> from flue gases in coal-fired power plants. In the course of this post-combustion capture proj-



↳ Demand for hydrogen is also rising in the chemical industry. From its hydrogen plant in Ludwigshafen (Germany), BASF supplies 90 plants at its multi-production site.

ect, the partners successfully tested a new CO<sub>2</sub> scrubbing agent during 2010. The solvent reduced energy consumption by 22 percent – a significant step since all methods of capturing carbon dioxide in coal-fired power plants increase energy consumption and lower plant efficiency.

Building on experiences gathered during the Niederaussem pilot project, RWE intends to construct a larger demo plant for CO<sub>2</sub> capture in Eemshaven, Holland, by 2015. By 2020, the CO<sub>2</sub> scrubbing process should be ready for commercialisation and capable of removing over 90 percent of carbon dioxide from power plant flue gases.

Linde is working on research projects with various partners and universities to explore the second generation of carbon capture technologies. One of the aims here is to optimise the efficiency of CO<sub>2</sub> separation processes. Sponsored by the German Federal Ministry of Economics, these projects include an initiative to investigate the oxyfuel process with circulating fluidised-bed combustion.

Under this umbrella, Linde and RWE have signed a framework agreement to deploy technology developed by RWE for drying lignite prior to combustion. Linde will thus be in a position to supply and deliver fluidised-bed drying with internal waste heat utilisation (WTA).

## Award for technology leadership

The H<sub>2</sub> Mobility initiative, that Linde is a partner of, has received the Excellence in Leadership Award from the International Partnership for Hydrogen and Fuel Cells in the Economy (IPHE). The prize was presented at the World Hydrogen Energy Conference (WHEC) on 17 May 2010 in Essen, Germany. This IPHE award goes to institutions or initiatives that play a particularly outstanding role in advancing hydrogen and fuel-cell technologies.

WTA technology reduces the moisture content of raw lignite by over 55 percent, to 12 percent. This is achieved at a temperature of only 110°C, instead of the 1,000°C required by conventional drying processes. Additionally, the heat used to dry the lignite is largely recovered and put to further use.

The WTA process looks set to boost the efficiency of future lignite-fired power plants by a total of 10 percent, to almost 50 percent overall. In a plant with 1,000 MW capacity, for instance, this would cut CO<sub>2</sub> emissions by up to a million tonnes annually.

## Eco-friendly vehicles

The international automotive industry is also challenged to reduce CO<sub>2</sub> emissions and conserve resources. Electromobility trends are increasingly focusing on the possibilities of battery-operated vehicles and fuel cells. This is placing the spotlight on hydrogen (H<sub>2</sub>) as an eco-friendly energy carrier. In September 2009, for instance, leading industrial players signed a memorandum of understanding intended to bring several hundred thousand fuel-cell vehicles to market starting in 2015.

## Expanding the hydrogen fuelling network

Successful market uptake of hydrogen-powered vehicles hinges on a supporting infrastructure. That is why the H<sub>2</sub> Mobility initiative aims to gradually increase the number of hydrogen fuelling stations in Germany, and pave the way for widespread commercialisation of fuel-cell vehicles from 2015 onwards. The founding members of this initiative are Linde, Daimler, EnBW, OMV, Shell, TOTAL, Vattenfall and the German national organisation for hydrogen and fuel-cell technology (NOW).

The Clean Energy Partnership (CEP) is also committed to commercialising hydrogen as the fuel of the future, focusing in particular on testing vehicles and fuelling stations under real-life conditions. This consortium currently numbers twelve companies: Linde, the Berlin transport services BVG, BMW, Daimler, Ford, GM/Opel, the Hamburger Hochbahn transport operator, Shell, Statoil, TOTAL, Toyota, Vattenfall Europe and Volkswagen.

In May 2010, CEP partners Linde, Statoil and TOTAL opened a second, state-of-the-art hydrogen fuelling station in Berlin. The new facility offers the eco-friendly fuel in both gas and liquid form. Linde is delivering the liquefied hydrogen, which is stored on site in highly insulated tanks, as well as the refuelling technology.

Another CEP fuelling station is currently being built in Germany's capital. Alongside an underground reservoir for liquid hydrogen, Linde is supplying its new cryopump fuelling system for this project. Outperforming all other stations of its kind in Europe to date, this facility is set to go live by mid-2011, enabling vehicles to refuel with high-pressure hydrogen at either 350 or 700 bar in just three minutes.

In another CEP project, energy provider Vattenfall will also open a public hydrogen fuelling station in the HafenCity district of Hamburg (Germany) by mid-2011. This will



## New H<sub>2</sub> fuelling stations in California

Linde is currently constructing a hydrogen fuelling station in Emeryville, California (US), for the regional bus operator AC Transit. Boasting the latest Linde technologies, this facility will supply fuel-cell buses and cars with compressed gaseous hydrogen at both 350 and 700 bar. The hydrogen will be delivered in liquid form and stored on site, while an electrolyser at the station will also generate around 60 kilograms of gaseous hydrogen per day. Alongside the Emeryville facility, Linde will set up another hydrogen fuelling station for AC Transit during 2011 to supply a bus depot in Oakland.

have sufficient capacity to supply a public fleet of 20 fuel-cell buses, and it will also be equipped with a pump for refuelling cars, making it Europe's largest hydrogen station. Linde is delivering this turnkey facility. Alongside two electrolyzers and tanks to store compressed gaseous hydrogen (CGH<sub>2</sub>), it will comprise two latest-generation ionic compressors and the dispensers (see glossary) required for refuelling at 350 and 700 bar.

## Green hydrogen

Even when hydrogen is generated by steam reforming (see glossary) fossil fuels such as natural gas – which is the most common method at present – its use in fuel-cell vehicles still reduces the total CO<sub>2</sub> footprint by around 30 percent compared with conventional fuels.

Linde's long-term aim, however, is to produce hydrogen from renewable sources and create a fully sustainable energy value chain. The company is working on various innovative technologies that rely on different approaches. At its Leuna site in Saxony-Anhalt (Germany), Linde commissioned a pilot plant during the reporting year to obtain hydrogen from crude glycerol. The glycerol occurs as a by-product when manufacturing biodiesel from plant oils. To convert it into green hydrogen, Linde uses its specially developed pyro-reforming method. This chemical/thermal process involves cracking the desalinated crude glycerol under high pressure and at temperatures of several hundred degrees Celsius. The resultant, hydrogen-rich gas is fed into Linde's existing, on-site hydrogen facilities for purification and liquefaction. The company intends to use green hydrogen obtained in this way to supply the new hydrogen fuelling stations in Berlin and Hamburg, for instance.

Another method of producing green hydrogen is gasifying waste biomass. Linde is working on this process with a partner and supported construction of a pilot facility to test this during the year under review.

## Desulphurising fuel

Not only is hydrogen itself a clean energy carrier, it also plays a significant role in reducing the environmental impact of conventional fossil fuels. In refineries, this industrial gas is primarily used to desulphurise petrol and diesel, lowering the emissions they release during combustion.

Linde strengthened its position in this market segment by commissioning a 22.5-kilometre hydrogen pipeline in the US during 2010. This connects the Shell refinery in Deer Park, Texas, with Linde's Texan hydrogen facilities in Clear Lake and LaPorte. Investment in this project amounted to around USD 50 m.

Linde's SURE™ technology uses oxygen to recover sulphur from petrochemical processes, offering environmental and economic gains. The company won a major reference customer in China for this innovative process during the reporting year: Yangtze Petrochemical Corp. (YPC), a subsidiary of the Sinopec Corporation. YPC has been deploying SURE™ in its refineries since September 2010 with the intention of increasing sulphur recovery from the present level of 70,000 to 100,000 tonnes per year.

## LNG from coal seam gas

The market for liquefied natural gas (LNG) is booming – not least because, as a fuel, LNG (see glossary) releases around 20 percent less CO<sub>2</sub> than conventional diesel during the combustion process.

In Australia, Linde is collaborating with the Queensland Gas Company (QGC) to obtain LNG from coal seam gas for the first time. QGC is to deliver the coal seam gas, which Linde will then liquefy in a new LNG plant near Miles, Queensland. The plant is set to produce 50 tonnes of LNG per day, equivalent to around 70,000 litres of diesel. This will be used to refuel heavy goods vehicles and for industrial applications. The first gas deliveries are scheduled for summer 2011.

Linde is also planning to set up a network of eight LNG fuelling stations on Australia's east coast. This will be supplied by both the new plant in Queensland and another liquefaction facility in Tasmania.

## EU study confirms hydrogen is key to zero-emission mobility

Hydrogen-powered fuel-cell vehicles will play an important role in tomorrow's low-emission mobility landscape. This is one of the conclusions of the most comprehensive European study to date investigating the future prospects of different powertrains for private vehicles. The study's balanced scenario anticipates that fuel-cell vehicles will account for 25 percent of total passenger cars on the road in the year 2050. This will require an investment of around EUR 3 bn to establish a Europe-wide infrastructure of hydrogen fuelling stations by 2020.

The study shows that, compared with battery-electric vehicles, fuel-cell vehicles have the benefits of greater range and faster refuelling. Fuel cells are therefore the lowest carbon solution for medium/larger cars and longer trips. This segment accounts for approximately 50 percent of all vehicles and 75 percent of all CO<sub>2</sub> emissions by road traffic.

The total cost of ownership (TCO) for all powertrains is expected to largely converge by 2025 – or sooner in light of tax exemptions and incentive systems. The hydrogen infrastructure only accounts for around five percent of the total costs. The complete study can be found online at [www.zeroemissionvehicles.eu](http://www.zeroemissionvehicles.eu).

# Spotlight.

## Clean solar cells

The photovoltaic industry is also moving rapidly towards production processes that are cleaner and lower in price. Manufacturers of solar cells are striving to reach grid parity (see glossary) and make solar power a competitive alternative to other energy carriers – even without subsidies. The sector is also aiming to achieve green parity, producing solar cells – and thus solar power – without any negative impact on the environment. That is why increasing numbers of manufacturers are replacing the cleaning gas nitrogen trifluoride ( $NF_3$ ), which is extremely harmful to the climate, with more eco-friendly fluorine ( $F_2$ ). And thanks to Linde's generators, this can be produced cost-effectively on site. This technology is becoming increasingly established worldwide, particularly in the manufacture of thin-film solar cells (see glossary).

Linde has also launched a cost-effective entry-level system for the use of fluorine in producing silicon solar cells: SPECTRA-F™. This process enables solar cell manufacturers to test deployment of pure fluorine on a laboratory and pilot scale.

## Advances in biotechnology

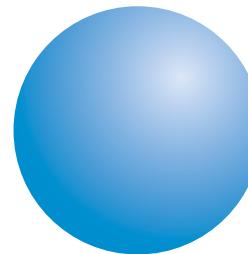
In the field of biotechnology, too, Linde is researching methods and applications supporting the sustainable creation of products that conserve resources. To further progress in this area, the company is currently establishing the Chemical-Biotechnological Process Centre (CBP) in Leuna, Germany, on behalf of the Fraunhofer Institute for Interfacial Engineering and Biotechnology (IGB). Here, new processes in industrial biotechnology will transition from the research stage to pilot scale, laying the foundations for the possibility of industrial-scale rollout.

Linde is also involved in designing and developing modern biorefineries to manufacture intermediate chemical products. These facilities offer an environmentally friendly and energy-efficient combination of biotechnological process steps and conventional chemical processes.

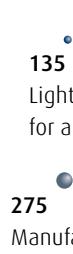
The company is now pushing planning for a green biorefinery in Brandenburg, Germany, for instance, which will produce biopolymers from renewable raw materials.

## People and the climate.

Closer look at some of our greenhouse gas emissions in kilograms.



**4,160**  
Return flight from  
Berlin to New York  
(per passenger)



**135**  
Lighting up a house  
for a full year



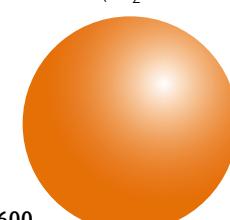
**275**  
Manufacturing a com-  
puter, screen included



**1,470**  
One tonne of non-  
recycled paper



**3,500**  
Cutting down trees in a  
100 m² patch of forest  
( $CO_2$  store is destroyed)



**3,600**  
Annual electricity consumption of a  
4-person household (supplied from  
a coal-fired power plant)

## Clean energy growth market.

Overview of Linde's clean energy engagement.

**Enhanced use of fossil fuels**  
Today's growth markets



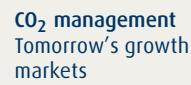
Liquefied natural gas (LNG)  
Gas-to-liquids (GTL)  
  
**CO<sub>2</sub> scrubbing**  
Removal of hydrogen sulphide and CO<sub>2</sub> from synthesis gas  
  
**Clean coal**  
CO<sub>2</sub>-reduced coal gasification

**Renewable energies**  
Emerging growth markets



Biomass-to-liquids  
Biofuels, from landfill gases for example  
  
**Geothermal**  
**Automotive hydrogen**

**CO<sub>2</sub> management**  
Tomorrow's growth markets



**Oxyfuel**  
Energy-efficient combustion with oxygen  
  
**Post-combustion CO<sub>2</sub> capture**  
CO<sub>2</sub> capture from flue gases using chemical solvents

2011  
2012  
2013  
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2016  
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2010  
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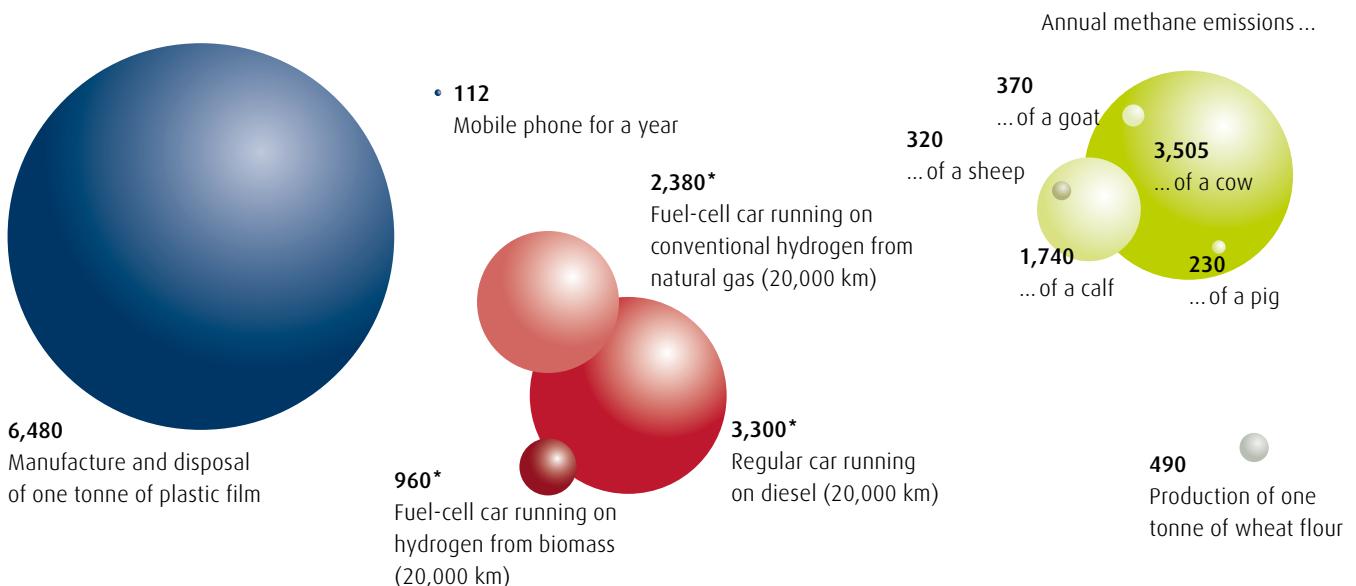
Business model Linde:

Engineering  
Gas supply

Maturity of business:

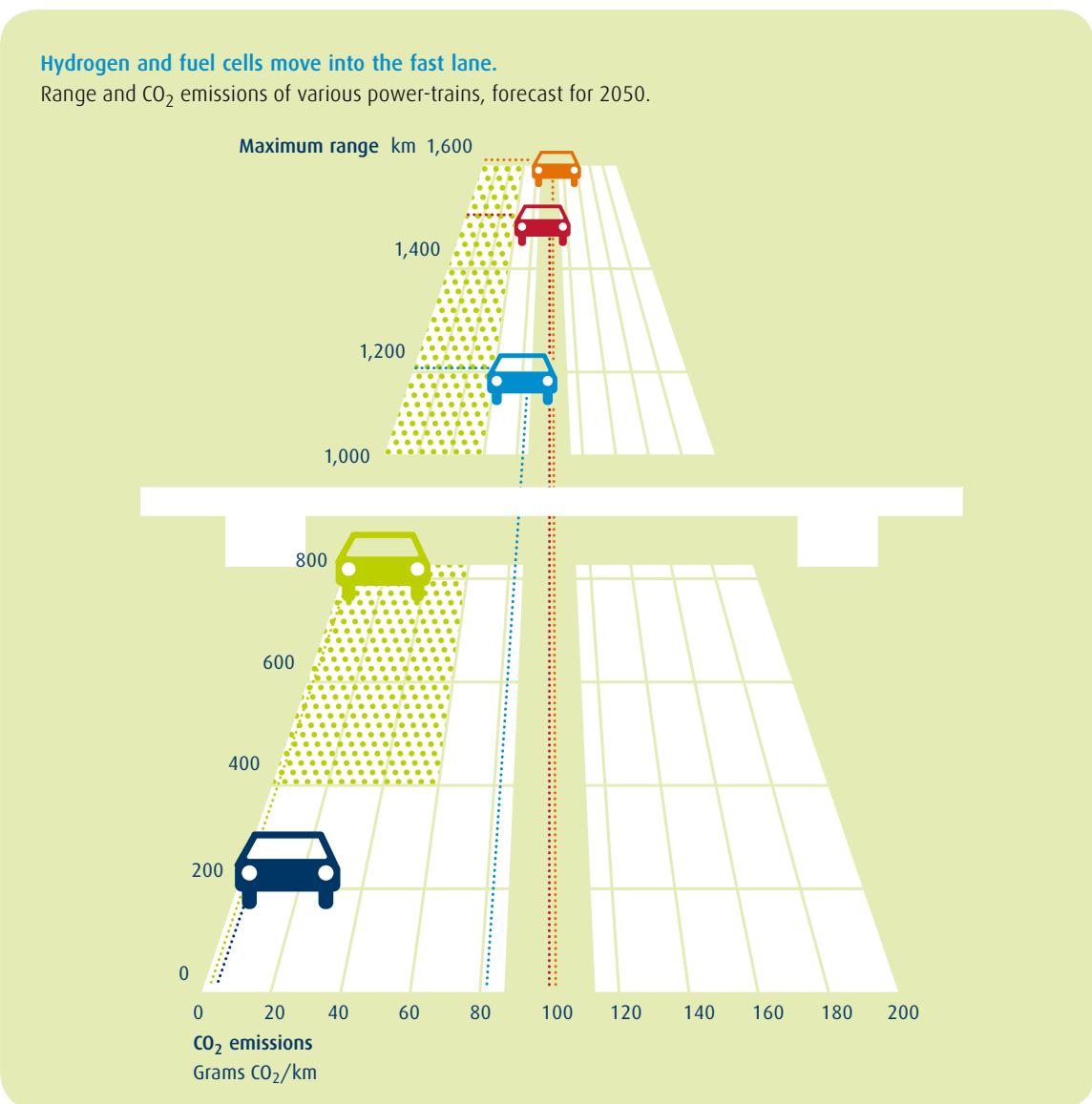
Existing business  
Pilot stage

Source: Linde AG, 2010.



Source: Globalisation Atlas.

\* A portfolio of power-trains for Europe: a fact-based analysis, McKinsey & Company, 2010, and Linde AG figures.



Source: A portfolio of power-trains for Europe: a fact-based analysis, McKinsey & Company, 2010.

↳ Manhattan, New York (US) -  
microcosm of a global world.





#### 4. Corporate Responsibility

## "Can a global corporation be a good neighbour?"

Enterprises with global operations must live their sense of corporate social responsibility across national borders. Linde is particularly committed in the fields of science and education, healthcare and environmental protection – all over the world.

# "Linde's commitment to education really sets an example."

The Carl von Linde Academy was founded at the Technical University of Munich (TUM) in 2004 thanks to an endowment by The Linde Group. Professor Klaus Mainzer, the Academy's Director, gives us his take on modern engineering studies.

Our company's founder, Carl von Linde, actually taught at the TUM – then a technical institute – at the end of the nineteenth century. So a partnership between Linde and TUM seems to be an obvious route at this stage?

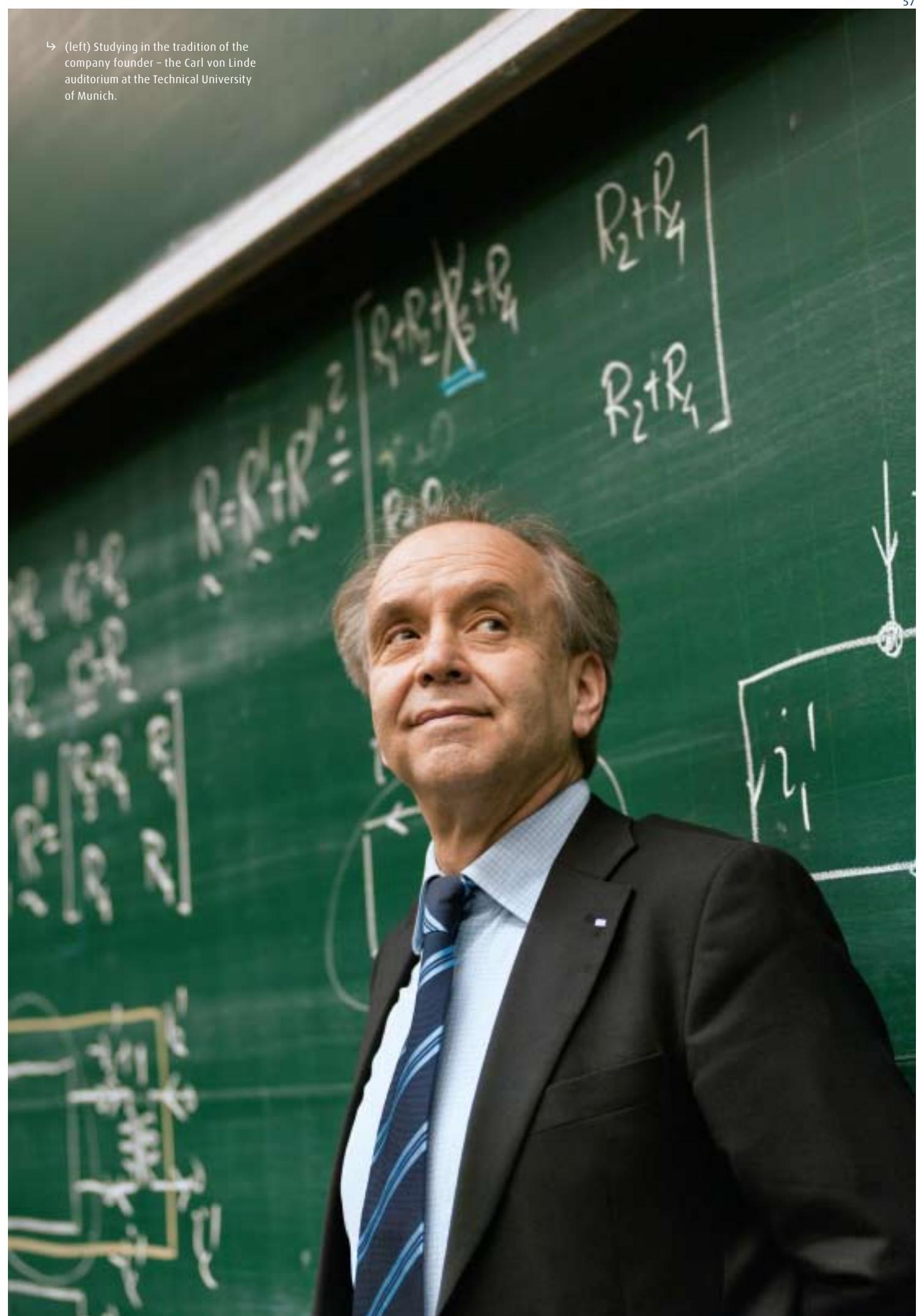
↳ Yes, Carl von Linde was a professor of mechanical engineering theory at what is now the TUM both before and during his time at the company. Several of his descendants also studied for degrees and doctorates here, as did Linde's current CEO. Indeed, as an honorary professor at the TUM School of Management, Wolfgang Reitzle still gives guest lectures for us. So there is certainly a long tradition of close ties between the two organisations. However, it is still exceptional for a company to support higher education to this extent. Linde's commitment really sets an example here.

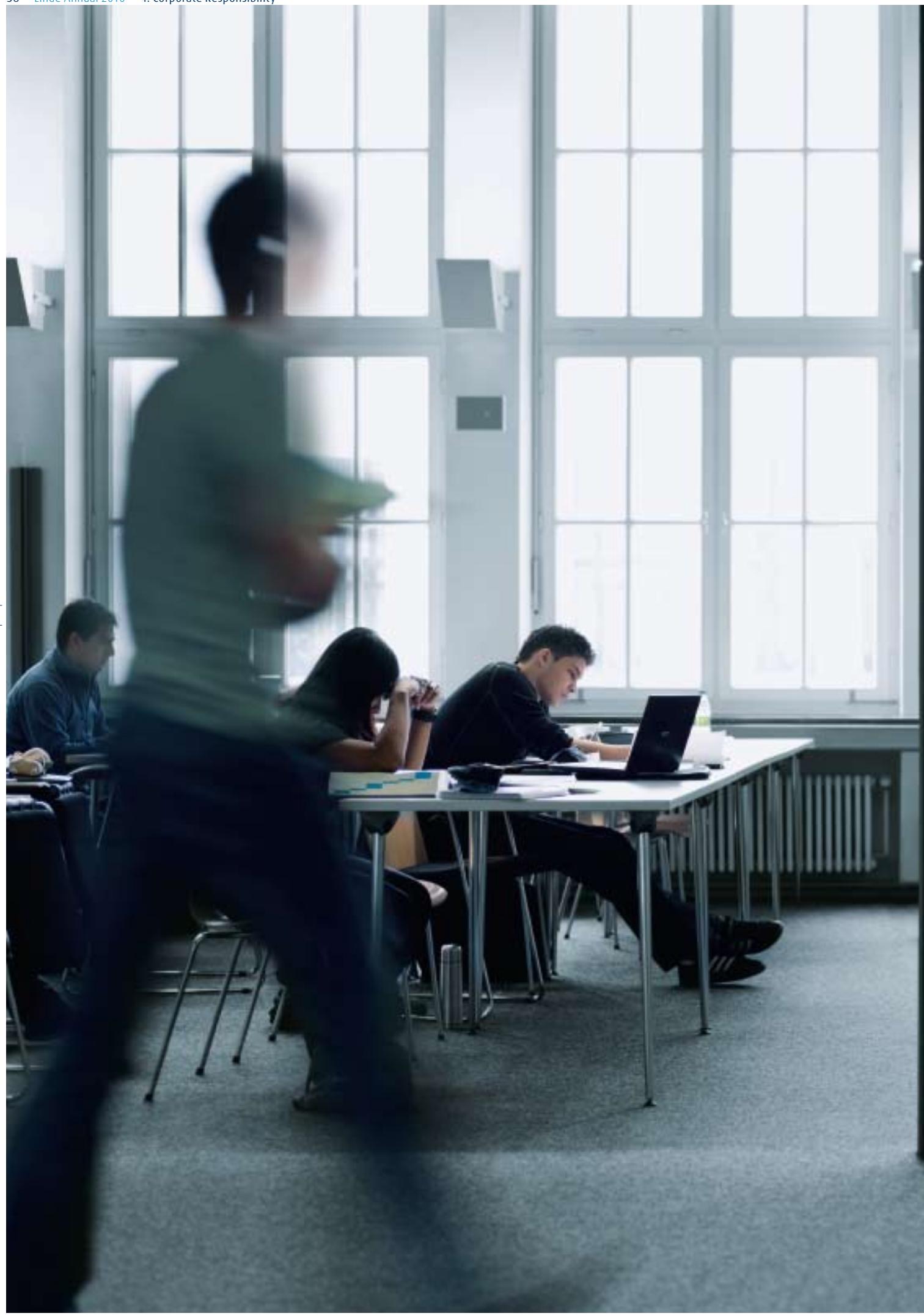
Since the times of Carl von Linde, our business environment has become more complex and globalised. What impact does this have on engineering studies?

↳ Conventional, highly specialised tuition is no longer sufficient for students who will need to take on managerial responsibility and excel in an increasingly complex business world. So the training concept at the Carl von Linde Academy does more than just teach technical expertise. My Chair of Philosophy and Scientific Theory offers a broad grounding in engineering that stretches across various different fields, for instance. We set great store by an interdisciplinary and intercultural approach. →



↳ (left) Studying in the tradition of the company founder – the Carl von Linde auditorium at the Technical University of Munich.





A photograph showing several students sitting at long, rectangular white tables in a large classroom. They are focused on their work, with papers and notebooks open in front of them. The room has large windows with multiple panes, letting in natural light. The students are dressed in casual attire like hoodies and t-shirts.

What does that mean in concrete terms? Or how exactly are you equipping the next generation of engineers for future challenges?

↳ We engage outstanding lecturers to teach interdisciplinary modules that complement our courses of study. Our creative techniques seminar, for instance, fosters networked, interdisciplinary thinking and problem-solving. And on the communication front, we help future engineers to interact more effectively with graduates from other disciplines during their subsequent careers. We also prepare them for the cultural differences that are now part and parcel of daily business with international companies.

What future do you see for the Carl von Linde Academy and its partnership with The Linde Group?

↳ Well, we have a clear win-win situation here. Linde's generous endowment means we are able to select first-class lecturers, who then train and inspire tomorrow's engineers for a future role with the company. We currently number over 2,000 students per semester – and that figure is on the rise. It even looks like our training concept is getting ready to travel – we have already received enquiries from educational institutions abroad.

↳ Over 2,000 students attend the Carl von Linde Academy each semester.

# "We give disadvantaged children a chance."

Tintswalo Sono's responsibilities at Afrox, member of The Linde Group, include managing voluntary social activities by employees. Here she explains the importance of these efforts – particularly for the African continent.

Afrox participates in numerous social projects in South Africa and other African countries. What is the thinking behind this engagement?

↳ As a company, we are aware that the places where we do business are also home to local communities and we influence those communities through our activities. For Afrox to be successful, the communities need to be economically and socially strong. We also want to make some small contribution to African development as a whole.

**So what do you focus on here?**

↳ We focus in particular on education and training, as that is the only real way to break the poverty cycle. Each year, we make donations amounting to one percent of our net profit after tax (NPAT). In this field, they go towards helping underprivileged pupils with maths and science. As a leading supplier of gases and welding equipment, we also support welding schools. Plus we provide not-for-profit organisations with welding equipment, industrial gases and liquid petroleum gas (LPG).

**And you also support voluntary work by your employees?**

↳ Yes, through our staff-driven Community Involvement Programme (CIP). Here, our employees make active voluntary contributions to projects in their professional or private capacities. So they invest their time and knowledge to support various community institutions, concentrating on orphanages and care centres for abused, abandoned and disabled children. →





**How many of these projects are you currently supporting?**

↳ We currently have around eighty projects in this programme, helping more than 7,000 children. Afrox also assists individual homes, where our employees provide assistance in their spare time. As you can see, we stand 100 percent behind our employees' good efforts.

**What was/is in your eyes the most important achievement of Afrox's social investment?**

↳ Well, as you can imagine, every single project, every contribution to a good cause is hugely valuable. I suppose one of our biggest achievements is that our school for maths and science, originally set up for older pupils, is now able to extend its offering to younger children from one of South Africa's poorest areas. We give these children a chance to go on to third-level education, which would previously have been unthinkable for them. Our programme has also been recognised by the United Nations as a model community involvement programme.

**And where does the annual Bumbanani Day come in?**

↳ The motto of this day, which we celebrate once a year, says it all – "let's build together" (rough translation of "Bumbanani"). Afrox employees get together for a fun day with the causes they support. This day is a celebration of the continuing relationship that we have built with the community. Functions held throughout sub-Saharan Africa are attended by thousands of children and Afrox employees.

↳ Afrox, member of The Linde Group, helps to set up and run community institutions in South Africa.

# Contributing to local communities.

Linde is at home in over one hundred countries worldwide. This global footprint calls for a sense of corporate and social responsibility that transcends national boundaries. So wherever Linde employees live and work, the company gets involved – no matter where in the world that might be.

## S

4

### Strong local roots

For Linde, being a good neighbour means taking responsibility – as a business partner, an attractive employer and a corporate citizen committed to actively fostering social engagement and cohesion. Across the globe, Linde Group companies participate in numerous projects, particularly in the fields of education and science, community involvement, healthcare, environmental protection, art and culture, and sport.

Around the world, a number of local companies and major production sites celebrated big anniversaries in 2010. Their achievements over the decades were varied and impressive. These include successfully establishing themselves as key players in local economies, taking responsibility for training young people, supporting regional projects and initiatives and providing local aid in times of crisis.

2010 marked a major anniversary for Linde in Leuna (Saxony Anhalt, Germany), for instance. 20 years ago, the company established operations on the premises of the former national chemical corporation VEB Leuna, as one of the first private investors to establish a footing in the former GDR following German reunification. Powered by investments totalling around EUR 500 m, Linde evolved this site into one of Europe's largest and most

modern gas hubs over the subsequent years, creating 430 jobs and 35 training positions in the process. Linde's engagement also tipped the scales for several other companies, which then also established operations at Leuna.

Meanwhile, in India, Linde subsidiary BOC found a special way to celebrate its 75th year of business in the state of West Bengal. In collaboration with the local non-governmental organisation (NGO) Mukti, company volunteers planted 7,500 trees in villages in the Sundarbans (English: "beautiful forest") mangrove area that had been ravaged by Cyclone Aila in May 2009.

### Teaming up

Social engagement has many different faces and facets at Linde. The company assists organisations with long-standing experience – such as NGOs – with their projects in addition to running its own social programmes. Linde also supports the voluntary efforts of its employees in their local communities, for example with projects helping children and young people or relief efforts following natural disasters.

Linde's regional subsidiary in North America has made a tradition of its annual Giving Campaign, for instance. Here, volunteers organise various initiatives to collect donations for charitable causes and organisations, and the company then doubles the final sum through its matched giving scheme. The success of this initiative is growing, with over USD 380,000 raised in 2010 – 12 percent more than in 2009.



↳ (top) Africa's future: Linde supports disadvantaged children.

↳ (bottom) Fostering talent – Linde supports German boarding school Schloss Hansenberg as part of a public-private partnership.



→ Star turn in the classroom – employees from Linde Group member BOC spark interest in science.

The number of participating employees has also increased by one third relative to the previous year.

At the African subsidiary Afrox, a big percentage of employees is currently active in the company's regional Community Involvement Programme (CIP). They work with the local authorities in the various Afrox locations throughout South Africa and various other African countries to identify pressing needs and align their aid activities accordingly. Support for disadvantaged children is a top priority here.

## Investing in research, education and science

Linde is particularly committed to long-term support for projects that harmonise with the company's own philosophy and strategy. Initiatives that promote research, education and science are one such focus, for instance, as are projects to which Linde can contribute its dedicated know-how as a technology player and industrial gases expert.

A case in point is the BOC subsidiary's programme "Inspiring Gases" in the UK. This initiative supports schools and other educational institutions in strengthening pupils' interest in

the natural sciences – for instance with presentations and seminars on the properties and applications of industrial gases.

## Fostering tomorrow's talent

Linde's commitment to research, education and science also includes promoting particularly talented young people and supporting institutes of higher education. Linde is collaborating on individual projects or joint research and development efforts with several German universities.

At the Carl von Linde Academy, the Technical University of Munich (TUM) gives budding engineers and scientists – computer scientists included – a grounding in intellectual, cultural and social studies that extends far beyond pure technical knowledge. Part of the Chair of Philosophy and Scientific Theory, the Academy's curriculum includes interdisciplinary instruction in ethics and responsibility. The Academy also provides further training for mathematics and science staff. Linde sponsored the Academy with an endowment of over EUR 8 m.

Another notable aspect of Linde's drive to foster talent is its involvement in the Schloss Hansenberg boarding school in Hesse, Ger-

## Following in the footsteps of Carl von Linde

The Deutsches Museum in Munich, Germany, is one of the largest natural science and technology museums in the world. It is home to over 100,000 objects, including many originals and masterpieces documenting technology breakthroughs over the ages, all of which are displayed for public viewing. In order to preserve this valuable collection, the premises need to be renovated and advanced to state of the art. As one of the founding members of the museum's Future Initiative programme, Linde is supporting these measures with a total of EUR 5 m over the next decade. With this donation, the company is following in the footsteps of Carl von Linde, a founding member and major patron of the Deutsches Museum.

## HELP in South & East Asia

**4** Linde has developed an umbrella programme to bundle its wide-ranging aid, sponsorship and environmental activities in the South & East Asia region. Under the banner "We want to HELP in leading efforts to bring about a better tomorrow", the company and its employees have launched numerous initiatives designed to help improve lives – providing healthcare, supporting education for children and young people, delivering assistance especially in disaster situations and protecting the environment. HELP stands for four areas that are particularly important to Linde: Healthcare, Education, Local community development/assistance (engagement) and Protecting the environment.



↳ Relief work in Thailand – Linde TIG employees donated food and water to victims of flooding.

many, as part of a public-private partnership (see glossary). The other partners supporting this upper-secondary school for exceptionally talented and motivated pupils are Commerzbank and the Robert Bosch Stiftung (non-profit foundation), as well as the state of Hesse. This programme extends beyond financial backing to include practical assistance with the curriculum in the form of internships and periods abroad. Around 200 pupils currently attend the school.

### Protecting the environment

Environmental protection is a high priority for Linde. This is evident not only from the company's own production processes and development focus on eco-friendly products and technologies, but also from the range of projects it actively supports in this area.

The "Where There's Water" environmental programme in New Zealand stems from an initiative by Linde employees, for instance. Dedicated to active pollution control, this project is run by the environmental organisation Water New Zealand with financial support from the local Linde company.

Another example is the HELP programme for Southeast Asia. Alongside providing healthcare, rapid emergency relief and support for educational initiatives, Linde also focuses on environmental projects here. Water protection was a key theme in Malaysia during the year under review. Linde and other neighbouring companies in Penang's Free Industrial Zone launched a major programme to clean the nearby river Parit MOX, named after Linde's subsidiary Malaysian Oxygen (MOX). The companies are supplying the necessary biological materials, while their employees are investing their free time to form thousands of mud-balls made of red earth, molasses, bio-compost and bacteria. This biological purification method stops algae growth, inhibits pathogen

development and regulates the ammonia content of the water.

## Spotlight on medicine – saving lives

As a leading provider of medical gases, it is a matter of course for Linde to support health-care projects as part of its corporate citizenship activities.

The international medical association INTERPLAST provides free reconstructive surgery in developing countries, performed by doctors working on a voluntary basis. Over the past 13 years, the organisation has treated over 50,000 patients during a total of 520 trips. The supply situation at the destinations is usually poor, posing real challenges for doctors requiring reliable oxygen supplies. In contrast to Western industrialised countries, the ready availability of oxygen – the most commonly used pharmaceutical product worldwide – is by no means assured in many developing areas. This prevents many comparatively simple procedures such as cleft lip and palate repairs from being performed – with grave consequences for the health and social status of those affected. During the year under review, Linde provided Interplast's humanitarian volunteers with the equipment for on-site oxygen generation: nine mobile oxygen concentrators. These are earmarked for INTERPLAST trips to Ecuador, Sierra Leone, Rwanda, Tanzania and Nepal.

Linde's regional subsidiary in Australia has been supporting the Redkite organisation inspired by an employee initiative there. Redkite is a national charity that provides practical, financial and educational assistance for children with cancer and their families. Over the past year, Linde has increased its long-standing commitment to this organisation and now offers its employees in Australia and New Zealand the chance to donate part of their paid annual leave (Kitetime) to Redkite in the form of a cash payment.



→ African communities need to be economically and socially strong – and Linde is determined to help.

## Home for orphaned and abandoned children

The New Jerusalem Children's Home may only be a small welfare institution near Johannesburg (South Africa) but it certainly has a large aim: to become the best children's home in Africa. It looks after children who have been orphaned or abandoned by their parents before the age of 16. Many of them have been abused, traumatised, injured or have developed AIDS. Founded in the year 2000, the institute receives some support from the Ministry of Social Affairs but is largely dependent on donations. Thanks to these, the number of children it can look after continues to grow – at present it cares for 90. The house is part of an agricultural operation that acts as a trust, forming the financial backbone of the establishment. Linde Process Plants, a subsidiary of Linde's Engineering Division based in Johannesburg, began making donations to the New Jerusalem Children's Home during the year under review.

## Rapid disaster relief

In emergency situations, the priority is fast and unbureaucratic aid – through money, relief supplies and on-site assistance. In 2010, rapid help was needed after catastrophic flooding in Pakistan that also affected Linde employees, whose houses were seriously damaged or even completely destroyed. The company immediately swung into action to help with rebuilding. Linde provided financial support and granted paid leave to employees who wanted to give voluntary assistance. Staff donations from Pakistan and the South & East Asia regional head office in Singapore were also collected, amounting to around EUR 112,000. This money went to two local not-for-profit organisations specialised in emergency flood relief and reconstruction in Pakistan.

In Thailand, flooding devastated 21 provinces in the past year and made 890,000 people homeless. Here, again, Linde employees and their families were affected. The company set up temporary accommodation near its premises and provided food, drinking water and financial support. People affected in the company's neighbourhood in the province of Saraburi also received emergency aid. In addition, Linde made a corporate donation to the national flood relief fund, while employees at various locations organised a project to collect donations of money, rice and dried foodstuffs for victims of the flooding.

Following the severe earthquake in Haiti in January 2010, Linde's North American subsidiary immediately began working with the American Red Cross and set up a website for employee donations. These came to over USD 30,000 in total, which the company matched to reach a total contribution in excess of USD 60,000. The Linde Group Corporate Centre in Munich also supported local aid organisations with an additional donation of EUR 100,000.

# Spotlight.

## North America:

**Giving Campaign.** In 2010, employees at Linde North America again collected money for charitable causes as part of the annual Giving Campaign. The company matched the funds raised (see page 62).

## USA:

**Saving flood-damaged homes.** Linde employees stepped up to the plate in 2010 following floods in Nashville and Middle Tennessee – giving time, money, medical supplies and an electricity generator that helped to speed up repair work on flood-damaged houses. As a result of these efforts, thirty family homes were saved from demolition.

## Haiti:

**Emergency relief.** Linde North America collaborated with the American Red Cross in the aftermath of the devastating earthquake to raise donations (see page 65).

## UK and Ireland:

**Network of “knowledge ambassadors”.** Under the motto “It’s a Gas”, Linde experts from the UK & Ireland Regional Business Unit visit schools and universities to raise interest in industrial gas applications.

**Fostering interest in research.** The BOC Gases Challenge is a competition run in secondary schools aimed at inspiring pupils to come up with innovative ideas in the area of chemical technology. The two best entries receive a prize.

## Germany:

**Supporting the scientists of tomorrow.** The Carl von Linde Academy at the Technical University of Munich is sponsored by Linde. The academy provides young engineers, computer scientists and other natural scientists with a solid base in intellectual, cultural and social studies.

**Science at your fingertips.** Carl von Linde was one of the founders of the Deutsches Museum, and Linde continues in his footsteps as patron of one of the world’s largest science and technology museums today.

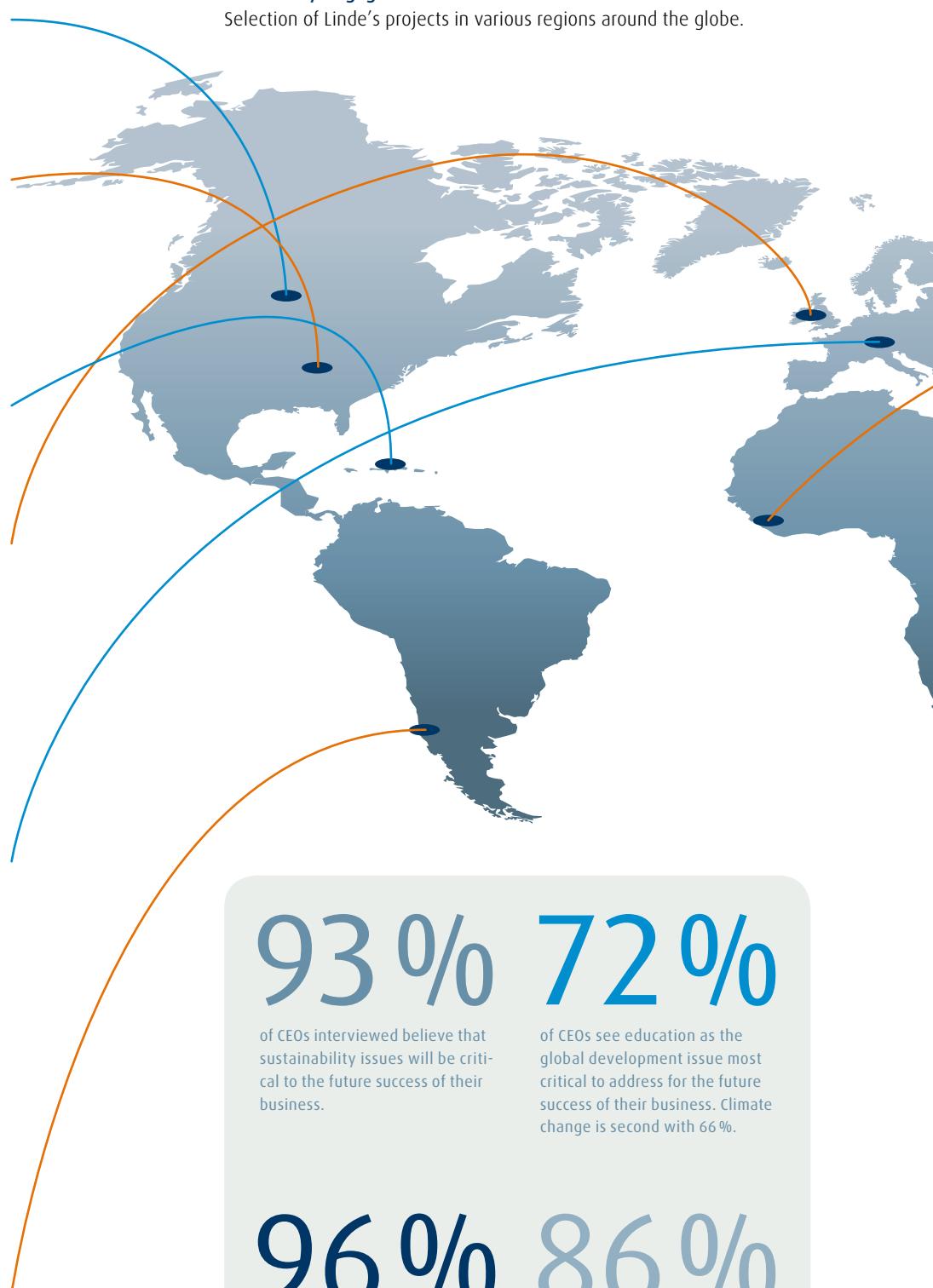
**A first-class education.** Linde is a partner and sponsor of Schloss Hansenberg, a secondary boarding school for especially talented and motivated pupils.

## Chile:

**Voluntary aid.** Following the earthquake in Chile in February 2010, destroying around half a million homes, dedicated Linde employees organised and participated in emergency assistance for those afflicted.

## Community engagement worldwide.

Selection of Linde’s projects in various regions around the globe.



**93 %** **72 %**

of CEOs interviewed believe that sustainability issues will be critical to the future success of their business.

of CEOs see education as the global development issue most critical to address for the future success of their business. Climate change is second with 66 %.

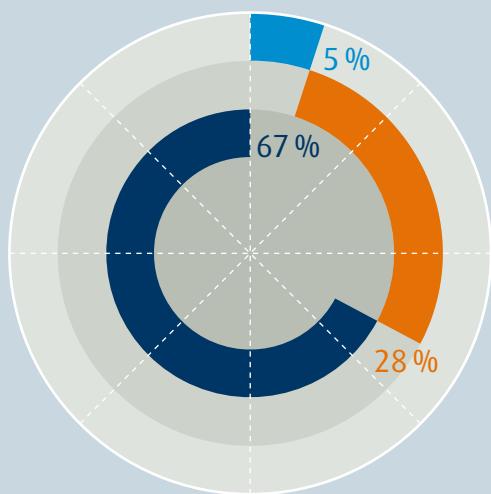
**96 %** **86 %**

of CEOs believe that sustainability issues should be fully integrated into the strategy and operations of a company (up from 72 % in 2007).

of CEOs see “accurate valuation by investors of sustainability in long-term investments” as important to reaching a tipping point in sustainability.



**Corporate Responsibility moving up the corporate agenda.**  
A survey of decision-makers in business shows that Corporate Responsibility is growing in importance.



Source: Corporate Social Responsibility, Bertelsmann Stiftung.

#### Pakistan:

**Emergency relief.** Linde and its employees donated time and money to help in the aftermath of the catastrophic floods of 2010 (see page 65).

#### India:

**Help for devastated villages.** Employees of BOC, a member of The Linde Group, teamed up with a regional NGO to plant trees in villages devastated by 2009's cyclone Aila (see page 62).

#### Australia and New Zealand:

**"Redkite" for children with cancer.** In Australia and New Zealand, Linde employees and local companies help support children with cancer and their families via the charitable organisation Redkite (see page 64).

#### New Zealand:

**Protecting water supplies.** The New Zealand environmental programme "Where There's Water" was initiated by Linde employees. Its goal is to actively promote water conservation (see page 64).

#### Malaysia:

**Clean river.** Linde and other companies on the banks of the Parit MOX river started a programme to clean up the waterway in 2010. The companies provide the materials and employees donate their free time, making thousands of mud balls from red earth, molasses, bio compost and bacteria to biologically clean the water (see page 64).

#### Sierra Leone:

**Humanitarian aid with oxygen from Linde.** Two oxygen concentrators donated by Linde ensure a secure supply of this critical gas for a hospital near Lunsar. During a three-week humanitarian project, for instance, these concentrators enabled around 130 surgical procedures to be carried out.

#### South Africa:

**Annual budget for donations.** Linde Group member Afrox donates 1 percent of its profits every year.

**Employees helping children.** The Community Involvement Programme (CIP), an initiative of Linde Group member Afrox, supports community projects in Africa. Helping disadvantaged children is one of the key goals here.



## 5. Corporate Performance

# "Can you plan success?"

A company's success depends on many factors and forces, both external and internal. Here, the Executive Board members of Linde AG explain how they are equipping Linde for lasting success as the company moves forward.



↳ Growth symbol –  
the Shanghai skyline.

## "We will make Linde an excellent company."

Professor Dr Wolfgang Reitzle, Chief Executive Officer of Linde AG

↳ As executives of a leading company with a long and successful tradition, my colleagues and I have a clear mission – we must do everything in our power to keep Linde on the long-term path to success. Our job is to steer all of the forces within our sphere of influence so that Linde can realise its full potential.

This is a holistic strategy, with the aim of turning Linde as a whole into a High-Performance Organisation. This is about increasing efficiency – and not cutting costs. There are three key pillars within this strategy: a process landscape that dovetails to perfection, a high degree of standardisation and a solution-driven mindset among our people. And that means always finding the best solution for our customers, since we keep our processes very closely aligned with their requirements.

When it comes to benchmarking our performance, we look well beyond the boundaries of our own industry. For instance, to optimise our transport fleet, we take the world's leading logistics companies as our yardstick. →



↳ From left to right:  
Georg Denoke, Professor Dr Wolfgang Reitzle,  
J. Kent Masters, Dr Aldo Belloni.



At Linde, we synchronise and harmonise all our processes with our IT systems. Over the coming years, our intention is to gradually standardise these systems, ultimately achieving a single, unified IT template.

Our holistic strategy does not stop on some arbitrary deadline. It is an ongoing process. The underlying approach – perhaps best described as a culture of dynamic performance and achievement dedicated to the goal of continuous improvement – is something we want to firmly anchor within our company values.

This will lay a stable foundation for lasting profitable growth, putting us in an even stronger position to tackle long-term megatrends such as energy, healthcare, environmental protection and emerging economies. So leading the transition to clean energy becomes, if you like, part of our corporate DNA. We have both the right technologies and the expertise needed to master every possible scenario in the post-oil era. We know how to execute major projects effectively and are in a unique position worldwide to build on synergised gases and engineering know-how.

At this stage, no-one can accurately predict whether we will be able to rely on stable, widespread and lasting economic growth. That is outside our sphere of influence. But of one thing I can be certain: together, we will make Linde an even better company than it already is. We will make Linde an excellent company with a unique identity – a leader that is exemplary and inspirational in every respect.



↳ A shining symbol – courtyard at Linde Corporate Centre in Munich.

# "There is always room for improvement."

**Dr Aldo Belloni, Executive Board member of Linde AG**

↳ Excellent processes make for an excellent organisation – and that certainly goes for our company too. As far as we are concerned, the key to process excellence lies in standardising to the greatest possible extent. So, at Linde, we develop global standards that all have one thing in common – they must ultimately be of benefit to the entire Group. We have deliberately chosen a collaborative approach to defining these standards, which means that every single executive and employee is called on to play their part. This enables us to bundle the extensive know-how embedded throughout our company and ensure the best possible return on that knowledge.

An excellent company must constantly be looking for ways to improve. And this extends even to new processes, since there is always room for improvement. We maintain a pragmatic, needs-based approach here, putting our newly defined standards to the test, examining the results and then making adjustments wherever necessary.

Take, for example, the supply chains behind our bulk and cylinder gases business. We are gradually increasing the levels of standardisation here, without losing sight of our overarching goals – absolute reliability and maximum safety.

Turning to our engineering business, we are aiming to increase efficiency even further on global projects that span multiple disciplines or regions. Specifically, this will involve closer cross-team collaboration and streamlining technical specifications.



↳ Process expertise in action:  
The on-site plant operated under the Shanghai  
HuaLin Industrial Gases joint venture in China  
uses synthesis gas instead of natural gas.





**"Leading company – admired above all for our people."**

J. Kent Masters, Executive Board member of Linde AG

↳ The calibre and motivation of employees can make or break a company. That is why it is so important for us at Linde to put the right people in the right jobs. People who go about their work – even daily tasks – with a positive and questioning attitude. People equipped with all the skills and knowledge they need to do their job. And, above all, people who are proud to work for Linde.

However, this attitude is not necessarily innate. It is a mindset that grows and evolves and we, as executives, must lead by example. We encourage that mindset by rewarding outstanding results, in keeping with our culture of dynamic performance and achievement, and by promoting collaboration across organisational borders. We believe in actively engaging and motivating our employees, and expressing our appreciation. It is important that each individual sees how they fit into the big picture and contribute to the company's success.

This requires significant investment – in our people. We offer our employees a wide range of personal development opportunities, with programmes tailored to individual skill levels and job profiles.

Ultimately, training is the best way to realise our vision of becoming "the world's leading global gases and engineering group – admired above all for our people."

↳ Working together – Linde employees in Murray Hill, New Jersey (US).

↳ Up-and-coming financial hub – downtown Singapore.



## "We are creating head-space for further growth."

Georg Denoke, CFO and Executive Board member of Linde AG

↳ Linde is committed to long-term, profitable growth. Accomplishing this means we have to make important decisions every day. How can we best use the resources at our disposal, for instance? Or which lines of business do we want to actively develop and expand? The challenge here lies in finding the right balance between sectors in which we already have a very strong footing and promising new opportunities. These include the windows being opened up by global megatrends such as energy, environmental protection and healthcare, but also the chance to further strengthen our position in emerging economies in Asia and South America, for example.

Our portfolio management strategy helps us make the right choices. We defined various investment categories and priorities at both regional and product levels. The overarching aim for Linde now is to expand our core gases business. At the same time, we need to remain flexible so we can systematically capitalise on the openings presented by global megatrends. We will be stepping up our investment activities in these areas.

The productivity gains currently in focus, coupled with a steady increase in our cash flow, will create the headspace we need for this growth. By gradually increasing performance across the Group, we are creating a springboard for promising business opportunities and continued profitable growth.



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## Contact information

### Linde AG

Klosterhofstrasse 1  
80331 Munich  
Germany  
Phone +49.89.35757-01  
Fax +49.89.35757-1075  
[www.linde.com](http://www.linde.com)

### Communications

Phone +49.89.35757-1321  
Fax +49.89.35757-1398  
E-mail [media@linde.com](mailto:media@linde.com)

### Investor Relations

Phone +49.89.35757-1321  
Fax +49.89.35757-1398  
E-mail [investorrelations@linde.com](mailto:investorrelations@linde.com)

Our Annual Report, which includes The Linde Annual and the Financial Report of The Linde Group, is available in English and German. You can download either version from our website at [www.linde.com](http://www.linde.com). You will also find an interactive version of the Annual Report online.

If you require any additional information about The Linde Group, please contact our Investor Relations department. Our staff would be delighted to send you anything you need free of charge.



## Review of the year

### JANUARY

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↳ Linde establishes a sponsored Level 1 American Depository Receipt (ADR) programme in the US. ADRs are certificates representing a specified number of shares in a foreign stock. They are traded over the counter (OTC) in the US. Ten ADRs correspond to one Linde share.

↳ BOC Healthcare, a member of The Linde Group, concludes a contract with the National Health Service (NHS) in Scotland to supply medical gases to ambulance services throughout the country. The agreement covers the provision of medical oxygen, the analgesic gas mixture ENTNOX® and gas delivery systems. The company will be supplying over 160 ambulance stations across the whole of Scotland.

### FEBRUARY

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↳ Linde is awarded a contract from Xinjiang Ji Munai Guanghui Liquefied Natural Gas Development Co. Ltd in China for an LNG plant with a capacity of 400,000 tonnes per year. In 2004, Linde successfully started operations at a similar LNG facility commissioned by the same customer. The new plant in the north-west province of Xinjiang is scheduled to go on stream at the end of 2011.

↳ Linde and Bosch Solar Energy AG expand their collaboration at Bosch's crystalline silicon solar cell manufacturing site in Arnstadt, Germany. Under the new agreement, Linde will supply silane and ammonia gas, both critical materials in the fabrication of PV cells. Bosch currently operates three manufacturing facilities in the Erfurt/Arnstadt area that produce both thin-film and crystalline silicon solar cells. At peak performance, the crystalline facilities alone have an overall capacity of 630 MWp (megawatt peak), making the Erfurt/Arnstadt area a strong European 'solar cluster'. Linde is the main gas supplier to all of the production lines here.

### MARCH

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↳ Linde opens the southern hemisphere's first helium plant in Darwin, Northern Territory, Australia. The plant has an annual capacity of 4.3 million cubic metres of helium – enough to cover Australia's needs and cover exports to New Zealand and other Asian markets. This valuable noble gas has a variety of applications including the production of semiconductors, LCD screens and fibre optic cables. It is also used in medicine and for filling balloons and airships.

↳ Linde starts construction on Pakistan's largest air separation plant in Lahore. The company will be investing around EUR 17 m in the plant. With a 150 tonne-per-day (tpd) capacity, the facility will primarily supply the growing regional market in northern Pakistan with liquid and gaseous products (oxygen, nitrogen and argon). The plant is scheduled to be completed in the first half of 2012. It will mainly serve customers in the steel, glass, food, chemical, oil, gas and medical industries.

### APRIL

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↳ Linde announces that, from 2010 onwards, customers in the electronics industry will be able to reduce CO<sub>2</sub> emissions from production processes by a quarter of a million tonnes by replacing nitrogen trifluoride (NF<sub>3</sub>) with fluorine (F<sub>2</sub>) produced on site. This is the same amount of CO<sub>2</sub> emitted each year by 125,000 large family cars. The move underscores Linde's commitment to providing semiconductor and solar cell manufacturers with cost-effective and – above all – sustainable production solutions.

↳ In the UK, Linde unveils a new 150 Watt mobile generator powered by hydrogen fuel cells. The Hymera generator is both quiet and ecologically sound. It harnesses the chemical reaction between gaseous hydrogen and oxygen to produce electricity and its only "emission" is water.

↳ The leading international rating agencies Standard & Poor's (S & P) and Moody's increased Linde's rating by one notch; S & P from BBB+ to A- and Moody's from Baa1 to A3.

### MAY

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↳ The world's largest steel company, ArcelorMittal, awards Linde a contract to build a large, state-of-the-art air separation plant at the steelmaker's site in Temirtau, Kazakhstan. The on-site facility will be the first major air separation plant in Kazakhstan and have a capacity of 2,000 tpd. It is scheduled to go on stream in mid-2012. This is Linde's first engineering and operating win for an air separation plant in Kazakhstan. The investment volume for the new plant is around EUR 95 m. It marks Linde's entry into the emerging Kazakhstan market.

↳ Linde agrees to expand its supply infrastructure for steel manufacturer ThyssenKrupp Steel Europe at its largest production site in Duisburg (Germany). The agreement will see Linde construct a further major air separation plant in Duisburg-Ruhrort. The on-site facility will be the eleventh air separation plant that Linde has built for this customer at this location. It will have an oxygen capacity of 1,500 tpd and is scheduled to go on stream in the third quarter of 2012. Investments in the new plant and existing facilities at Duisburg-Ruhrort will total around EUR 75 m.

↳ For even greater financing flexibility, Linde agreed a new EUR 2.5 bn five-year revolver credit line. This facility replaces the EUR 2 bn credit line from 2006, which was originally due to run until May 2011, and the EUR 1.6 bn forward start credit line agreed in June 2009.

### JUNE

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↳ RWE Power and Linde sign an umbrella agreement to predry lignite with a technology developed by RWE Power. Linde-KCA-Dresden GmbH is now a provider and supplier of RWE Power's technology for fluidised-bed drying with internal waste-heat utilisation (WTA). In future, the procedure will be used in lignite power plants and coal liquefaction and gasification projects in order to raise energy efficiency levels and cut CO<sub>2</sub> emissions during power generation and synthesis gas production.

↳ Californian transport operator AC Transit contracts Linde to build two hydrogen fuelling stations in Emeryville and Oakland and to supply the hydrogen and necessary fuelling technology. The bus operator transports customers between thirteen cities in the San Francisco Bay Area. The stations will supply enough hydrogen to power twelve buses and up to 20 fuel-cell cars.



## Review of the year

### JULY

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↳ Linde secures two new gas supply contracts for Yangtze Petrochemical Company Limited (YPC) and Dynamic Chemical Company Limited at the Nanjing chemical industrial park in the Chinese province of Jiangsu. To secure future supplies, Linde will invest around EUR 24 m in the expansion of its existing gases infrastructure here. Projects include construction of a new air separation plant that will supply customers in the industrial park and the regional market with liquefied products.

### AUGUST

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↳ Linde agrees to expand its carbon dioxide (CO<sub>2</sub>) supply infrastructure at various locations in Malaysia and the US. The company is investing around EUR 15 m in the construction of a new CO<sub>2</sub> plant in Terengganu, for example. The facility is scheduled to go on stream at the end of 2011 with a capacity of 200 tpd, making it Malaysia's largest producer of high-purity CO<sub>2</sub>. The investment strengthens Linde's position as the country's leading provider of industrial gases and CO<sub>2</sub>.

↳ Linde commences operations at a new 600 tpd CO<sub>2</sub> purification and liquefaction plant in Fulton, New York (US). The raw CO<sub>2</sub> feedstock is a by-product of ethanol production and sourced from a neighbouring chemical company. The majority of the high purity CO<sub>2</sub> is destined for the food and beverage industry and has to meet strict quality standards.

↳ A CO<sub>2</sub> purification plant also starts production at Linde's electronic gases site in Medford, Oregon (US). The plant produces ultra-pure carbon dioxide (above 99.9997 percent) for various applications in the semiconductor and electronics industries.

### SEPTEMBER

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↳ Linde officially opens a new major air separation plant in Scunthorpe, UK. The on-site facility has an oxygen capacity of 1,600 tpd and is part of a long-term deal to supply Tata Steel's steelworks with gaseous oxygen by pipeline. Tata also awarded Linde a contract to modernise an existing air separation plant at the same site.

↳ Since 2009, RWE, Linde and BASF have been testing a new technology for capturing carbon dioxide (CO<sub>2</sub>) from flue gases emitted by a pilot facility at an RWE power plant in the German town of Niederaussem, near Cologne. The results from the practical tests are now available and show that, in combination with chemical solvents, the new technology uses around 20 percent less energy to capture CO<sub>2</sub> than current conventional processes.

### OCTOBER

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↳ Linde wins a contract from steel manufacturer Taiyuan Iron & Steel Company Limited (TISCO) to construct two new major air separation plants at its production site in Taiyuan, in the north Chinese province of Shanxi. The contract entails an investment of around EUR 100 m. The project will be managed by BOC-TISCO Gases, the 50/50 gases joint venture set up by Linde and TISCO. The two new air separation plants will be built for BOC-TISCO Gases by Linde's Engineering Division. With each plant having a 2,000 tpd capacity for gaseous oxygen respectively, these facilities are among the largest and most modern air separation facilities in China.

↳ Linde supplies BMW's forklift fleet at its Spartanburg, South Carolina, plant with hydrogen. Over 85 of the forklift trucks that keep the assembly lines supplied with vehicle components are gradually being converted from battery to fuel-cell technology. The hydrogen conversion will make this part of BMW's internal logistics entirely emissions-free. It is one of the largest hydrogen projects of its kind and highlights the potential value of hydrogen in intralogistics.

### NOVEMBER

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↳ A study reveals that hydrogen-powered fuel-cell vehicles are set to play an important role in creating low-emission road transport choices as we move forward. This is the conclusion reached by the most extensive European study investigating different powertrains in passenger cars. The results of the study were presented in Brussels on 8 November<sup>1</sup>. Linde and 29 other companies and organisations from the automobile, oil and gas, energy and utility and industrial gases sectors provided extensive data for the project. The study addresses the EU and G8's goal of achieving an 80 percent cut in overall CO<sub>2</sub> emissions by 2050, which will also involve decarbonising the road transport sector by as much as 95 percent.

↳ Linde undertakes to expand its gas supply infrastructure for GCL-Poly Energy Holdings, China's leading manufacturer of polycrystalline silicon (polysilicon). The investment volume for this project is around EUR 15 m. Polysilicon is primarily used in the solar industry. The new agreement includes the construction of new production and supply facilities for ultra-pure hydrogen (H<sub>2</sub>) in the Xuzhou industrial park. Two new production plants, set to go on stream mid-2011, will double current hydrogen capacity.

### DECEMBER

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↳ The one hundredth tanker is successfully loaded with LNG at Hammerfest LNG, Europe's largest natural gas liquefaction plant, located on the island of Melkøya, 800 kilometres north of the Arctic Circle. The large-scale plant commenced operations at the start of 2008 and now runs at up to 104 percent of its design capacity. A performance test will be carried out after the regular check in Q2 2011 in order to verify plant performance. With the successful development and realisation of this LNG technology on such a large industrial scale, Linde has established this versatile, European technology as a strong contender in the LNG market. Melkøya is a valuable reference project for the company both from a technical and strategic perspective.

<sup>1</sup> Source: A portfolio of power-trains for Europe: a fact-based analysis, McKinsey & Company, 2010.

## Glossary

### → Dispenser

Pump at a (hydrogen) refuelling station including the filling hose and fuelling nozzle.

### → ECOVAR® system

Brand name for Linde's range of gas production systems installed on site at the customers' premises. ECOVAR® systems offer a high level of cost efficiency. Thanks to their standardised, modular design, these systems not only significantly reduce engineering, manufacturing and installation costs, they also lower maintenance effort and consumption of resources such as electricity and water in particular. ECOVAR® systems are thus a cost-efficient, flexible, reliable and environmentally friendly way to produce industrial gases.

### → Fischer-Tropsch synthesis

A process used to produce synthetic fuels. The raw material used for Fischer-Tropsch synthesis (FTS) is synthesis gas, a mixture of carbon monoxide and hydrogen. The synthesis gas can be produced from coal or natural gas (and also from oil fractions such as heavy oil). It is completely sulphur-free, although purification is sometimes required to achieve this. Consequently, the fuels produced by FTS are also completely free from impurities.

### → Fuel cell

A system in which hydrogen and oxygen react to form water without a flame (cold combustion), generating a significant amount of electrical energy. So fuel cells transform chemical energy into electrical power.

### → Gas-to-Liquids (GTL)

GTL involves converting natural gas to synthesis gas by adding oxygen and steam and further transforming this to hydrocarbons using Fischer-Tropsch synthesis.

### → Grid parity

This term from the energy industry refers to a situation whereby electricity from a solar plant or other renewable source reaches parity with grid electricity prices (from a coal-fired power plant, for example).

### → Ionic compressor

Ionic compressors represent a huge leap in the evolution of compression technology. Here conventional metal pistons are replaced by a specially designed, nearly incompressible ionic liquid. These organic salts remain liquid within a specified temperature range. The innovative design enables compression at a near-isothermal temperature. Which means that drivers can refuel much faster. A bus can be refuelled in just six minutes using Linde's MF-50 ionic refuelling system, for example. And the MF-90 refuelling system for cars takes only three minutes to fill the tank – which gives enough fuel for a driving distance of 400–600 km.

### → LINEX™ concept

Linde's product line for large-scale on-site air separation units. Supplies high-volume customers with air gases produced on site and distributes liquid gases to regional market.

### → LNG

Liquefied natural gas (LNG) is regarded as a promising fuel for future energy needs because of its high energy density, constant heat rating and high purity.

### → Magnetic resonance imaging (MRI) machine

Medical device used to display the internal structures of the human body. An MRI machine uses magnetic fields instead of X-rays to display a cross-section of a patient's body. The process is also known as magnetic resonance tomography (MR or MRT).

### → Public-private partnership

A public-private partnership (PPP) is a cooperation model between a government body and a commercial company. In a PPP, the government may be actively involved in the project work, or may delegate all project work to the private company.

### → REBOX® technology

Gas process technology from Linde targeted at the steel industry. REBOX® oxyfuel solutions have been successfully deployed by around 110 reheat and annealing furnaces across the steel industry worldwide. Using pure oxygen instead of air for combustion greatly increases combustion efficiency and heat transfer. This means increased throughput, decreased fuel consumption and lower emissions.

### → Steam reforming

A process for manufacturing synthesis gas, a mixture of carbon monoxide and hydrogen, from carbon fuels such as natural gas, benzene, methanol, biogas or biomass.

### → Synthesis gas (syngas)

A mixture of carbon monoxide (CO) and hydrogen (H<sub>2</sub>), syngas serves as an intermediate for the production of synthetic fuels and other products such as hydrogen, ammonia and methanol. It can basically be made from a gaseous, liquid or solid feedstock.

### → Thin-film solar cells

Solar cells made with extremely thin films of photovoltaic material, reducing production costs by decreasing reliance on expensive silicon wafers.

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**Linde AG**  
Klosterhofstrasse 1  
80331 Munich  
Germany  
Phone +49.89.35757-01  
Fax +49.89.35757-1075  
[www.linde.com](http://www.linde.com)