



Creating Chemistry

For a sustainable future

Issue one 2012

 **BASF**

The Chemical Company

Malaria: A winnable war?

United Nations advisor Jeffrey Sachs explains why malaria control is a battle worth fighting. Interview page 14

Also in this issue:

- 6 How Gary White and Matt Damon are realizing their vision of clean water for all.
- 28 Scientific advance or aberration? Two experts make the case for and against plant biotechnology.
- 36 Mission impossible? Mitigating the impact of the global freight boom.
- 50 Driving into the future: What's next for our love affair with cars?
- 58 Conductor Gustavo Dudamel explains what he wishes he had known when he was younger.

Contents



36 Logistical solutions to mitigate the impact of congestion and rising emissions.



44 What the cities of tomorrow will look like.



50 Automotive innovations to keep the world moving.

4 The world in figures

6 Spotlight: Water for life

Gary White, co-founder of the aid organization Water.org with Matt Damon, reveals how they're making their vision a reality.

Health and Nutrition

Cover story: Malaria

Malaria: The issue

8 Fighting the war on malaria
Malaria cases and deaths are falling. We examine the reasons for this and find out how the fight against malaria is succeeding.

12 The malaria cycle

Our malaria cycle infographic shows how malaria infects humans and how the disease spreads.

Malaria: The expert

14 The great campaigner

U.N. Special Advisor Jeffrey Sachs explains why we can win the fight, and the challenges that lie ahead.

Malaria: The reality

20 Making a difference

We look at what happened when one malaria-afflicted community received insecticide-treated bed nets.

Malaria: The science

24 Net value

We examine the science behind the innovations from BASF that are helping combat malaria.

26 Signs of our times

A look at some notable cultural and technological innovations that are capturing the spirit of our times.

Health and Nutrition

28 From 2 perspectives:

Plant biotechnology

Peter Brabeck-Letmathe and Dr. Hans Rudolf Herren share their views on plant biotechnology.

34 Viewpoint: BASF

Dr. Stefan Marcinowski, member of the Board of Executive Directors of BASF SE, explains BASF's viewpoint on plant biotechnology.

Logistics

36 The load ahead

As global freight volumes look set to soar again, we examine the issues and ask what's being done to mitigate the effects of congestion and rising emissions.

42 Social life

As the use of social media continues to expand, what are the connections that underpin its appeal?

Housing and Construction

44 Our urban future

Our review looks at how new technologies mean that the buildings of today are being built faster, higher and cheaper – with advantages for economy, society and the environment.

Mobility

50 What's driving the future?

As global demand for car ownership shows no sign of slowing down, we see how innovation is making automotive manufacturing more sustainable and affordable.

56 The year ahead

With reference to our magazine's topics, our 2012 calendar picks out some of the most significant global events for the year ahead.

58 Looking back

Acclaimed conductor Gustavo Dudamel explains what he wishes he had known when he was younger.

Welcome



to the first issue of *Creating Chemistry!* Our new magazine delves into the topics that are affecting our world today and will impact the future. We'll show you how BASF contributes to solving these issues. The magazine also invites experts to share their views. We want to present facts and figures that enable our readers to form their own opinions.

This issue has a special focus on health and nutrition, an area where chemistry can help in many ways: Examples include treated mosquito nets to fight malaria as well as crops that can produce sufficient yields even in dry climates with unproductive soils. Innovations are essential so that future generations can also enjoy a high quality of life – in a society full of opportunity, in a healthy environment and without financial hardship.

As the world's leading chemical company, BASF wants to help meet these challenges through innovations. This aim is reflected in our purpose as a company: We create chemistry for a sustainable future. We combine economic success, social responsibility and environmental protection. With research and innovation, we help our customers meet society's needs, both today and in the future.

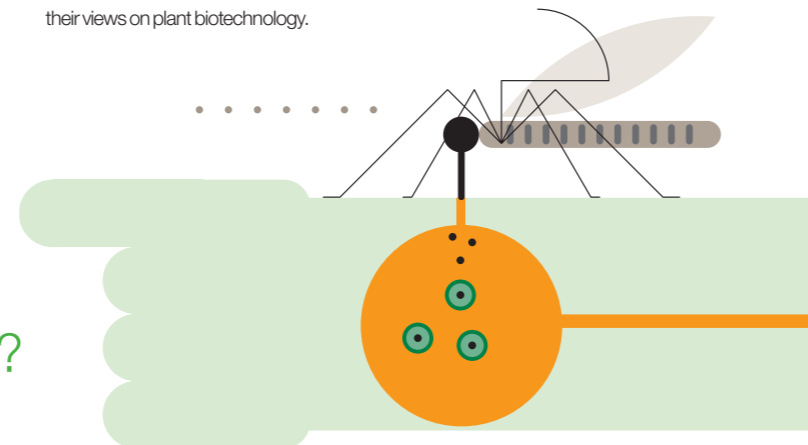
You can find out more about how we do this in our new magazine. I would appreciate it if you could take a moment to fill out the attached feedback sheet and let us know how you enjoyed this publication and what you'd like to read about in future issues. Each issue of *Creating Chemistry!* will have a special focus.

Please join us on this journey and discover sustainable solutions for today's world – and tomorrow!

Dr. Kurt Bock
Chairman of the Board of Executive Directors
BASF SE

Is this the beginning of the end for malaria?

8



The world in figures

The trends that are shaping our world

25%

25% of the world's total containerized exports came from China in 2010¹. See **The load ahead** on page 36



Energy & Climate Protection

80%

By 2020, up to 80% of goods will be manufactured in a different country than where they are consumed. The current figure is 20%².



417 million

By 2026, the number of cars in the Asia Pacific region is expected to reach over 417 million. More than 10 million cars were added to Asia Pacific's roads in 2011 alone⁶. See **What's driving the future?** on page 50

Mobility

15%

15% of overall greenhouse gas emissions in 2009 came from the transport sector⁷.



Housing & Construction

75%

It is estimated that 75% of people will live in cities by 2050³.



70%

Cities create 70% of global CO₂ emissions and consume over two-thirds of the world's energy⁴. See **Our urban future** on page 44

Health & Nutrition

40%

In 2010, 40% of the corn (maize) grown in the United States (some 5 billion bushels) was used for making ethanol⁵.



Health & Nutrition

85%

85% of all malaria deaths occur in children under the age of five⁸.



1 billion

1 billion people live without access to clean water⁹. See **Water for life** on page 6

Health & Nutrition

Fighting malaria



20%

Malaria causes 20% of all childhood deaths in Africa¹⁰.



289 million

289 million mosquito nets were delivered to sub-Saharan Africa between 2008 and 2010 – enough to cover 76% of the population at risk¹¹.



2000



2009

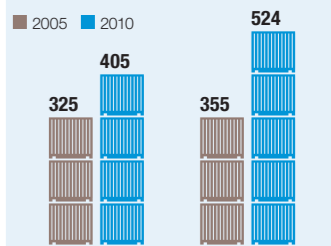
20%

Between 2000 and 2009, the number of deaths from malaria dropped by around 20%¹².

Energy & Climate Protection

Logistics¹³

Growth in export volumes from the E.U. and U.S., 2005 - 2010 (million metric tons):

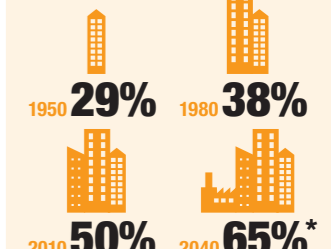


E.U. +25% U.S. +48%

Housing & Construction

World urban populations¹⁴

Today, more people live in cities than in rural areas.



% of people living in cities * estimate

Mobility

Car ownership



35 million

35 million new cars and trucks were sold worldwide in 2010 – the second largest number of annual sales recorded¹⁵.



95,500

Global traffic increases daily by 95,500 vehicles¹⁶.



2.7%

Biofuels provided 2.7% of the world's transport fuel in 2010¹⁷.

1. United Nations Conference on Trade and Development, *Review of Maritime Transport 2010*; 2. McKinsey & Company; 3. *New Statesman*, "Living in the endless city"; 4. Clinton Climate Initiative; 5. *The Economist*; 6. LMC Automotive (J.D. Power and Associates); 7. International Transport Forum, *Reducing Transport Greenhouse Gas Emissions: Trends & Data 2010*; 8. WHO/Roll Back Malaria (RBM); 9. Water.org, which cites report by UNICEF/WHO, *Progress on Drinking Water and Sanitation: Special Focus on Sanitation, 2008*; 10. WHO/RBM; 11. WHO/RBM, *World Malaria Report 2010*; 12. RBM; 13. United Nations Conference on Trade and Development, *Review of Maritime Transport 2010*; 14. United Nations, *World Urbanization Prospects: The 2009 Revision*; 15. www.wardsauto.com; 16. www.wardsauto.com; 17. Worldwatch Institute

Water for life

In 2009, Gary White and Matt Damon co-founded Water.org with the vision that one day everyone in the world will be able to take a safe drink of water. *Creating Chemistry* asked Gary White how they're helping to make that vision a reality.

Creating Chemistry: Tell us about Water.org.

Gary White: Water.org helps people get access to safe drinking water and adequate sanitation in developing countries. We do this in two different ways: Certain segments of people who are extremely poor require a subsidy approach, but we also started an initiative called Watercredit – which allows people living in poverty to get access to microloans so they can get their own water solution. For instance, in a slum someone might take out a microloan for \$100; that means they can afford to get connected to a water utility. Instead of spending hours each day scavenging for water in the slum, they can just have a tap right in their own home and can then repay that loan over two years.

How did you come up with the idea for Watercredit?

For 25 years now I've been focusing on this. I would meet people in slums in developing countries and see that they were sometimes paying 125% interest to loan sharks so that they could get a water connection in their home, or to buy a rainwater tank. It just made sense that if you could get them a loan at a reasonable rate instead of these usurious rates, there would be a lot of people who would no longer have to wait for charity. It can be decades

before an NGO comes along with the charity or subsidy approach.

What kind of working relationship do you and Matt Damon have together?

Matt has been incredibly engaged with this issue. He's not only a great human being but he's very smart and he's picked this up really quickly. We travelled in Africa and Asia together, visiting project sites and he asked a lot of great questions, and really came up to speed on the issue incredibly over the last few years. At a vision level and a strategy level, he's right there with me. And he's very engaged in really helping us tell the story.

Nearly one billion people are without access to clean water – your goal is to get that figure down to zero. Do you really think that's possible?

I do think it's possible – and in our lifetimes. It's a failure of imagination on our part if we can't figure out how to get it done. We've known how to make water safe in developing countries for more than 100 years. If we found a cure for AIDS today and 100 years from now there were still 3 million dying every year because of the disease – that would be unthinkable. And yet we know how to make water and sanitation safe because we've done it already for so much of the planet. We just have to figure out how to help everyone else catch up.

Facing page, top Water.org co-founder Matt Damon with children in Tigray, Ethiopia, at the community's previous water source. Today, locals have access to clean water from a village well provided by the scheme.

Facing page, below Slum residents in Hyderabad, India, celebrating their new water connection with Gary White and Matt Damon.

Below Gary White and Matt Damon discuss the water crisis with T. Nanda Vardhan, secretary with Water.org's local partner SIDUR, in a slum of Hyderabad, India.

All images courtesy of Water.org



Gary White

Gary White is Executive Director and co-founder of Water.org. As well as counseling organizations on responses to the global water crisis, he is a founding board member of the Millennium Water Alliance and Water Advocates. In 2008, he was inducted into the Philanthropy World Hall of Fame and in 2011, he and his Water.org partner Matt Damon were included in *Time* magazine's list of the world's 100 most influential people.

Do you think global companies can play a role here?

I do. They can start by reducing their water footprint because it is such a precious natural resource. Many corporations are already taking a serious look at this and reducing their demand on aquifers in the countries where they operate. I think there are also really good opportunities to engage business people in terms of some of these innovative solutions.

Water.org has been operating for a couple of years now. What's been the biggest highlight for you so far?

That's a great question – it's so hard for me to pick one moment. I just got back from India where I met these groups of women who had got water connected in their homes. The women were talking about how many of them were domestic servants now – they were actually able to go out for work and hold down jobs because they had their time freed up. That for me is the highlight – when you meet people like that and their lives have been transformed. You realize it goes beyond water: Water is the basic building block of any economy and also for the family. That's where it really pays off. ■



To find out more, visit: www.water.org

BASF's water focus

Dr. Ulrich von Deessen, President of BASF's Environment, Health and Safety Competence Center



In many regions of the world, water is a scarce commodity – in daily life and above all in agriculture. Any company involved in manufacturing must take care to use water economically and responsibly. At BASF, we focus on our own production, but we are also contributing to the development of products for improving water quality or for using water more efficiently. Product innovations such as filter membranes or complexing agents – which we are also developing in collaboration with our customers – help to purify water or to reduce contamination. Approximately one-fifth of our production sites are located in areas with a shortage of water. For us, this represents both a special responsibility as well as a mission to form and strengthen partnerships.





Fighting the war on malaria

Malaria kills 780,000 people every year – most of them in Africa. Its effects have trapped millions in an endless cycle of poverty, but thanks to a massive international push to control the disease, it may finally be losing its grip. Could this be the beginning of the end for malaria?

The statistics may appear bleak: Every 45 seconds a child dies of malaria and over 780,000 people in total die from the disease every year. Yet compared with two years ago – when it was estimated that a child died of malaria every 30 seconds, with nearly one million total fatalities worldwide – those figures offer some hope.

The truth is, cases of malaria are falling – thanks to what is arguably the most organized collective campaign against the disease the world has ever seen. Since the late 1990s, efforts to reduce the malaria burden have been gathering pace, with public health organizations, aid agencies, governments and private enterprises combining their resources. This is organized through a set of new inter-agency partnerships and initiatives that include the Global Fund to Fight AIDS, Tuberculosis and Malaria, as well as the President's Malaria Initiative in the United States, and Roll Back Malaria.

The collective effort is focused on achieving U.N. Millennium Development Goals (MDGs) – one of which is to halt and begin to reverse the incidence of malaria and other major diseases by 2015. The Roll Back Malaria partnership has taken this still further with a goal of near-zero deaths from malaria by 2015 – with the ultimate aim of eradicating malaria altogether.

20%

Malaria causes 20% of all childhood deaths in Africa.

85%

85% of all malaria deaths occur in children under the age of five.

40%

Malaria accounts for approximately 40% of public health spending in sub-Saharan Africa, 20% to 50% of inpatient admissions and 50% of outpatient admissions.

4.2 million

It is estimated that 4.2 million lives would be saved by full coverage of malaria control measures – i.e. use of nets, spraying, diagnosis, drugs – by 2015 in the 20 most at-risk African countries.

Below Pregnant women and children are the most vulnerable to malaria. It contributes to the deaths of an estimated 10,000 pregnant women and up to 200,000 infants each year in Africa alone.



So why malaria – and why now?

The poverty connection

Unlike other deadly diseases, malaria is both curable and preventable. Research has also demonstrated that the economic and social effects of malaria are devastating. Malaria keeps children away from school and adults from work; it pulls families into poverty and keeps them there.

Predictably, its greatest impact is on the world's poorest – those who simply cannot afford treatment or who have limited access to healthcare. Overall, malaria causes an average loss of 1.3% of annual economic growth in countries with high transmission rates. Tackle malaria and you go a long way to tackling

endemic poverty in many countries.

This isn't the first time the world has tried to stop malaria. In 1955, the World Health Organization (WHO) submitted an ambitious proposal for the eradication of malaria worldwide. Some countries managed it; others were less successful, with initial reductions followed by sharp increases once efforts ceased.

Climate apparently made the difference between success and failure: In temperate countries where malaria is a seasonal disease, eradication was possible. Not so for countries where malaria is rife all year round. The climate factor at least partly explains why it is sub-Saharan Africa that bears the brunt



Above Innovations in medicine and technology are allowing earlier diagnosis and more accurate treatment.

Percentage of households owning at least one insecticide-treated net, 2010

(Source: UNICEF global malaria databases 2011)



Left The distribution of insecticide-treated nets is central to malaria control strategy: These nets have been shown to reduce malaria transmission by 90%.

with 73 million people in Africa protected from malaria with IRS programs, up from 13 million in 2005.

The last decade has also seen the arrival of larvicides, a new generation of anti-malarial drugs, and Rapid Diagnostic Tests, which enable earlier diagnosis and more accurate treatment.

The distribution of these technologies together with better case management and education has delivered positive results. Eleven African countries have reported a decrease of at least 50% in malaria cases between 2000 and 2009. By 2009, the annual number of malaria deaths had fallen by 20% in comparison with the beginning of the millennium. In 2010, Morocco and Turkmenistan were certified by the Director-General of WHO as having eliminated malaria.

A challenging future

In other words, the push to reduce malaria cases is working – but there are still plenty of challenges ahead. Of particular concern is the distribution of nets. Roll Back Malaria estimates that 100 million LLINs must be financed and distributed globally every year, to sustain coverage and replace worn-out nets. But with distribution bottlenecks still an issue in some countries, this is proving difficult to achieve – as is the organization of IRS.

A resurgence in cases has been observed in parts of at least three African countries: Rwanda, Sao Tome and Principe, and Zambia. The reasons for this are uncertain, but one possible cause is a relaxation of control efforts; in Sao Tome and Principe, the resurgences followed a year in which IRS wasn't deployed, for example.

There is also the ever-looming threat of resistance to commonly-used insecticides, and drug resistance. In Cambodia, artemisinin-based drugs – currently hoped to be the most effective form of malaria treatment – are now taking longer to take effect. It's unclear as to why, but it was in the same region that resistance developed to the older antimalarial drugs chloroquine and mefloquine.

These challenges cannot be addressed unless the global community sustains its investment and interest in the 2015 goal. There is now growing concern that the campaign may fall victim to its own success: As the burden of disease falls away, political resolve could weaken and financial commitments diminish. Given the current global recession there is a genuine fear that malaria control could move down the list of development priorities. And yet there is hope: Only recently the U.K. government announced it would be increasing its investment in the malaria campaign, for example. If the global community manages to sustain momentum, the eradication of malaria could be a distinct possibility. ■

of the malaria burden: Around 90% of all malaria cases occur in Africa.

Critics are quick to question why, if eradication didn't work in the 1950s, it will work now. But much has changed: Advances in public health knowledge, treatment and technology have allowed the development of coherent and effective malaria control strategies, as set out by WHO and in the Global Malaria Action Plan.

Getting results

The last decade has also seen a series of innovations that make fulfillment of the 2015 goal achievable. The first of these is the long-lasting insecticide-treated net

(LLIN). Lasting at least three years, these nets have been shown to lower transmission by 90%, malaria incidence by 50%, and child mortality by 15%. Over the last few years, there has been a massive international push to deliver these nets: WHO has reported that 289 million nets were delivered to sub-Saharan Africa between 2008 and 2010. That is enough to cover 76% of the population at risk.

Indoor residual spraying (IRS) – where walls are sprayed with insecticide – has also been shown to reduce transmission, and WHO recommends it be used in tandem with LLINs. Here again, distribution has been impressive,

The malaria cycle

How malaria spreads – the cycle of infection

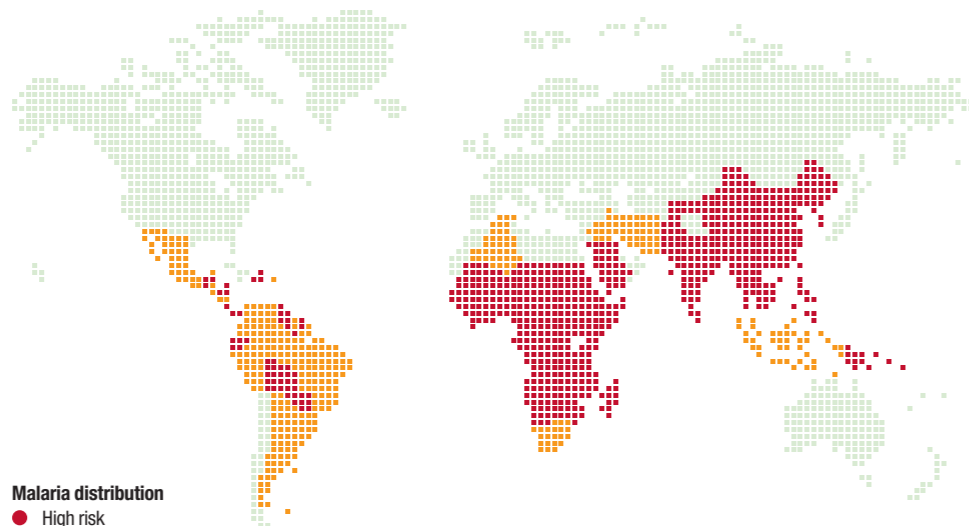
Malaria is a disease caused by a parasite called *Plasmodium*. It is transmitted exclusively through the bites of female *Anopheles* mosquitoes. When an infected mosquito bites a human, the parasites enter the blood. Within 30 minutes they infect the liver. Between six and nine days later, the parasites leave the liver and enter the bloodstream where they invade red blood cells. As the parasites multiply, the red blood cells burst, releasing thousands more parasites into the bloodstream where they infect other blood cells. It is at this point that the person will suffer from high fever, chills, nausea and anemia. When another mosquito bites the infected human, the parasite is transferred to that mosquito. While in the second mosquito, the malaria parasite goes through several stages of growth, which takes between 10 and 21 days, depending on the parasite species and the temperature. When the second mosquito bites someone else, the cycle begins again.

Why species and climate matter – the perfect storm

About 20 different *Anopheles* species are locally important around the world. Some prefer to bite animals, while others prefer to bite humans. Some have longer life spans, which gives the malaria parasite the time it needs within the mosquito to develop. If the mosquito dies, the parasite dies with it. The hotter the climate, the less time it takes for the parasite to develop.

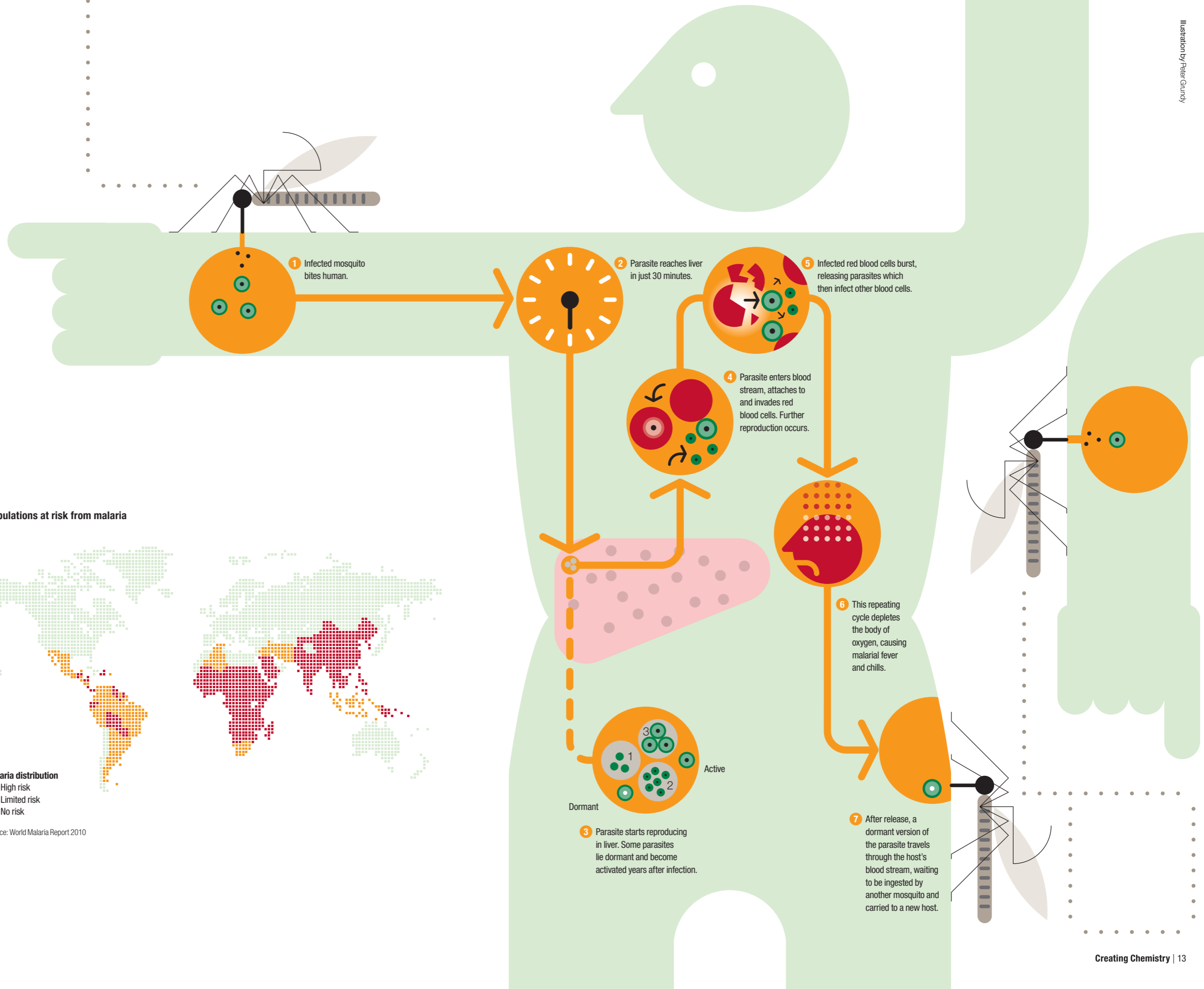
In sub-Saharan Africa, the *Anopheles gambiae* mosquito both prefers to bite humans and has a longer life span. The climate also allows the mosquito to survive year-round – and the heat helps the parasite to develop quickly. As if this weren't sufficient, Africa is also home to the deadliest form of the malaria parasite: *Plasmodium falciparum*. It is for all these reasons that an overwhelming 90% of malaria deaths occur in Africa. ■

Populations at risk from malaria



Malaria distribution
 ● High risk
 ● Limited risk
 ● No risk

Source: World Malaria Report 2010



Professor Jeffrey Sachs is the Director of The Earth Institute, Quetelet Professor of Sustainable Development, and Professor of Health Policy and Management at Columbia University in New York. He is also Special Advisor to United Nations Secretary-General Ban Ki-moon. From 2002 to 2006, he was Director of the United Nations Millennium Project, and Special Advisor to United Nations Secretary-General Kofi Annan on the Millennium Development Goals, the internationally agreed goals to reduce extreme poverty, disease, and hunger by the year 2015.

The great campaigner

An interview with Jeffrey Sachs

Can a disease as infectious as malaria ever really be controlled – and is it worth the cost of trying? The answer, according to Professor Jeffrey Sachs, is an unequivocal “yes.”



Pioneering economist Jeffrey Sachs has campaigned long and hard to engage the global community in the fight to end poverty – of which controlling malaria is a key part. Indeed, he was among the first to bring the importance – and feasibility – of malaria control to the world’s attention. Today, the malaria community is galvanized around the U.N.’s Millennium Development Goals (MDG) to halt and begin to reverse the incidence of malaria and other major diseases by 2015. As Special Advisor to the U.N. Secretary-General on the Millennium Development Goals, Sachs understands more than most what needs to happen to make the deadline.

Creating Chemistry: The developing world is beset with problems, from disease to conflict, weak governance and extreme poverty... why is malaria so important?

Jeffrey Sachs: Malaria is a major killer and barrier to economic development because not only does it cause illness and death, it impedes investment and has pervasive effects that delay or block economic growth. But it’s also an absolutely controllable disease, and one can make tremendous progress in fighting it at very low cost. So the combination of it being a major scourge and yet controllable makes it a very high priority for action.

One of the U.N.’s Millennium Development Goals is to halt and begin to reverse the incidence of malaria by 2015. Do you think this goal is still achievable?

The goal is being met right now. There’s a tremendous reversal in almost all parts of the world – most notably in sub-Saharan Africa, which is the epicenter of the global malaria burden. This progress could be even more dramatic between now and 2015 if the steps that are currently underway are strengthened and implemented as planned. Malaria stands out as one of the great success stories of the Millennium Development Goals.

Why has it been so successful?

Malaria is subject to rigorous control through a set of known and established protocols. Malaria control has two major dimensions: One is vector control* to block transmission, and the other is case management to treat cases of the disease. These are interacting because better treatment is also a kind of transmission control.

There’s been a suite of very important technologies not only developed but implemented in the last 15 or so years: a new class

of medicines based on artemisinin; new Rapid Diagnostic Tests which have removed the need for microscopy; much better vector control capability because of long-lasting insecticide-treated nets (LLINs); and better systems for community-based treatment. When you put all that together you have the potential for very significant control.

The other two things that have changed over the last 10 years are increased financing to implement these measures, and improved systems from the global to the local level. This has been a very, very major effort – and a fight also, to gain attention, to mobilize resources and build systems – but it’s bearing fruit.

So do you think working towards that goal is a matter of simply reinforcing what’s in place now?

There’s always a need for continuing innovation, especially since malaria medicines and vector control technologies can lose their efficacy through resistance – either of the mosquito to insecticides, or the parasites to medicine. What we know right now is that this very powerful combination of action requires a whole system of delivery. That means resources: natural resources, human resources, organizational capacity, political will. And keeping such systems in motion is not simple.

This is not a market-driven process by and large. It’s a public policy-driven process – which makes it harder than if this were a matter of selling products on an open market.

A tremendous amount of energy, leadership and intellectual effort needs to go into sustaining a high-intensity control effort. So far there has been a lot of progress – and it has required breaking through a lot of barriers of ignorance and indifference. In many parts of the world high income countries are needed to support much of this, and that has happened. Now we face another challenge: Rich countries are all in economic and political crisis right now. Whether they are able to sustain this effort is probably the most important question.

Do you think political will is waning?

Certainly in Europe, the United States and Japan, aid budgets are under attack – even though the total cost of malaria control that is needed at \$3 billion to \$4 billion a year is tiny. Mobilizing that level of funding is very difficult because malaria gets swept up in the general frenzy to cut development aid that is occurring in U.S. Congress and elsewhere. So this is a very difficult period. And I would say that in Europe,

the will to keep up this fight is limited and fragile. So we’ve had great success, but I don’t think we can guarantee against backsliding.

So how do you maintain momentum and keep donors engaged and committed?

Well, it requires a tremendous amount of legwork. In the early years I was heavily involved in campaigning: Helping to set up the Global Fund, the President’s Malaria Initiative in the United States, campaigning for the mass distribution of bed nets and many other components. And I can tell you – you face a lot of blank stares from senior officials for many, many years. So it requires people who are ready to spend a tremendous amount of time trying to educate, control, shame, pressure and advise people. We need as many champions of that sort who can speak loudly, clearly, boldly and ethically about this – I think this is key. Success requires a tremendous sustained effort by lots of stakeholders.

What role does private enterprise have to play?

Companies have a major role to play in providing quality products and improving technologies. And I would say [their role is also] critically – and unusually in some ways – working with public sector organizations, or multilateral organizations like the Global Fund, or working with the U.N. Secretary-General, to ensure that the public-private partnerships needed for success are operating effectively. So I think companies have multiple roles – both as developers and providers of technology, as capable scale managers, and as partners in public-private partnerships. And CEOs need to appreciate that they are among society’s most important political actors, because politicians listen to them. They have to explain to politicians who are overwhelmed, overstretched, and not necessarily aware of the great progress that has been made, that this fight against malaria needs to be sustained and scaled up.

For years you’ve argued the case for an integrated approach to tackling poverty – through fighting disease, increasing agricultural productivity and so on. The Millennium Villages project put the theory into practice in 33 villages – with positive results. Could you tell us a bit about that?

This project is now in about 15 countries. Leading scientists work together with local communities to apply best practice technology to achieve the Millennium Development Goals. >>

“Malaria stands out as one of the great success stories of the Millennium Development Goals.”

Jeffrey Sachs

”

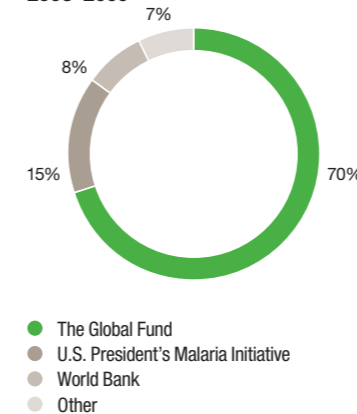
* A vector is an organism that carries pathogens that are transferable to humans – such as the malaria pathogen *Plasmodium falciparum*, which can be transferred to people via mosquitoes of the genus *Anopheles*.

Right Jeffrey Sachs, Special Advisor to the Secretary-General, takes part at the U.N. Global Compact Leaders Summit 2010 Closing Press Briefing, New York. On the left of the photograph is Chad Holliday, Chairman of Bank of America, and on the right of the shot is Georg Kell, Executive Director of the U.N. Global Compact.

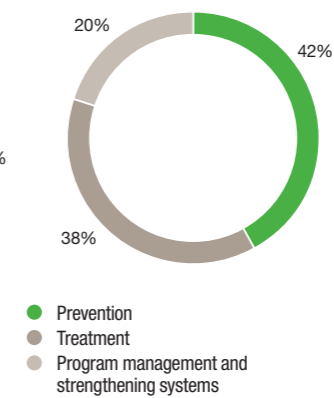


Funding the fight

Percentage of total malaria financing by organization, 2003–2009



How the funding support is used in Africa



Over the last decade, external funding commitments towards malaria control have increased over fifteenfold. Most of the funding is supplied via three organizations: the Global Fund, the U.S. President’s Malaria Initiative (PMI) and World Health Organisation (WHO), with the rest provided by around 18 countries and several agencies as bilateral funding. According to the Roll Back Malaria (RBM) partnership, there is a direct correlation between funding and intervention coverage – in other words, the funding works. Yet while funding levels appear to have peaked at \$1.6 billion a year, this is still just 25% of the estimated \$5 billion to \$6 billion a year needed to achieve the Millennium Development Goals for malaria.

Source: RBM’s report *Malaria Funding and Resource Utilization: The First Decade of Roll Back Malaria*.

Annual funding commitments of the Global Fund, World Bank, U.S. President’s Malaria Initiative (PMI), countries and multilateral donors participating in the Development Assistance Community (DAC)



Source: RBM’s report *Malaria Funding and Resource Utilization: The First Decade of Roll Back Malaria*.



Left United Nations Children Education Fund's former executive director Ann Veneman and leading U.S. economist Jeffrey Sachs dance with Kenyan students in Sauri village, Siaya District, 450 kilometers west of the Kenyan capital Nairobi. Veneman and Sachs visited Sauri to look at development projects targeting children.



Left For many people, health clinics are simply too far away, making integrated community-based treatment essential.

Malaria control is one of the priorities. We use a community-based malaria control methodology: mass distribution of LLINs, community health workers to help households use the nets properly, and a community health workers' system which covers all households to observe cases of malaria in the community and then apply treatment within the community – saving the time required to travel to clinics and thereby saving many lives.

Community health workers carry mobile phones with an expert, text message-based system to enter the results of Rapid Diagnostic Tests for individual patients, and then receive instructions by text on dosage and follow-up advice for the households. So this is the holistic system of community-based malaria control including vector control and case management. It is cutting edge, and the results are striking: a very significant reduction of malaria incidence, mortality rates in children under five, and overall disease burden from malaria across sites. The project has built systems for highly successful, on-the-ground malaria control.

What would you say to the criticism that the results of the Millennium Villages can't be replicated everywhere?

It's the opposite. In Nigeria, the Millennium Village project is being taken from two main sites to 113 local government areas; so from a coverage of about 50,000 people to about 20 million people. We just signed an agreement with the government of Rwanda to scale up the lessons of the Rwandan villages to a national scale. Similarly, we'll proceed in Senegal with the same type of scale-up. So the use of systems – especially information and communications technology (ICT) systems that are readily replicable and that can be documented and rigorously costed – is why this project is so important.

We've also issued a world report on optimum deployment of community health workers and we've estimated the cost of such deployment to be roughly \$5 to \$6 per villager in a rural area. We're working with governments to scale up community-based health workers as a frontline tool in the control of disease. Not just for malaria, but also with other problems such as chronic hunger and safety in childbirth.

So the whole project is designed for scale-up by using open source ICT and using vigorous costing and system development.

Why is such an integrated approach so important?

Significant gains have been achieved by the mass distribution of LLINs –

something for which I campaigned for over a decade. But I've also stressed that vector control needs to be combined with effective case management. And in the African context, effective case management can't be done as a clinic-based service – [clinics] are often too far away, transport is weak, there are too few higher-level health workers such as registered nurses or clinical operatives – so we need community-based treatment. But this requires a system: training of health workers, logistics, staffing, supervision, monitoring, data management. So you can't do these things haphazardly or with the magic bullet of something as wonderful as the LLINs.

A lot of the public discourse is about the magic of the single tool, and of course it's good for the public to understand some of the key inputs. But it worries me a lot because [while] the big success of the last couple of years has been the mass distribution of bed nets – and there is more availability of artemisinin-based combination therapies – there hasn't yet been a proper scaling up of primary health systems. This is what the Global Fund should invest in, but it is under financial attack by donor governments in the West, basically because of the spillover of the budget crisis. And I think this is the weakest point of the malaria campaign right now. The 2015 campaign will not work unless we massively scale up the training and supervising of health workers.

Isn't government corruption still also a major challenge?

I regard this to a very large extent as an information challenge as much as a morality challenge, in that the mismanagement and misuse of money is a phenomenon everywhere in the world. There has to be very strong diligence. We have to use ICT to make sure inputs go where they're supposed to go and to make sure we're tracking outputs and outcomes so that we know how these projects are doing and can make adjustments as necessary.

What would you like to see happen next?

The single most important thing right now is that the Global Fund for financing malaria control should remain robust to 2015 and should support the scaling-up of primary health systems globally – especially community-based malaria control strategies around community health workers. If this is done – if the Global Fund is properly financed, and if countries are able to obtain funding from it for effective community-based malaria control, we will succeed. ■

A vaccine against malaria?

Developing an anti-malaria vaccine has proved challenging – but after decades of research, two recent breakthroughs are inspiring new hope. First, a vaccine called RTS,S from pharmaceutical company GlaxoSmithKline. According to a study published in the *New England Journal of Medicine* around 15,000 infants and young children were vaccinated with RTS,S with promising results. This is the first time a vaccine has reached this stage of clinical development. A long-term analysis is not yet available, but initial findings indicate that in one group of children, the risk of contracting malaria was reduced by as much as 56%. The number of severe cases of malaria also fell by 47%.

The vaccine's effectiveness is still too low for widespread use – a vaccine is not usually considered for production until it is effective in 70% to 80% of those vaccinated.

The second recent breakthrough holds even more promise: Scientists at the Wellcome Trust Sanger Institute in Cambridge, U.K., have discovered a single receptor the parasite needs to be able to invade human blood cells and complete its life cycle in the human body. It is hoped that this discovery of the parasite's 'Achilles' heel' can be exploited to develop an effective vaccine that could contribute to the eradication of malaria worldwide.

However, experts say it's too early to celebrate just yet: It is still unclear how a vaccine could be distributed to everyone, especially in the poorer areas of Africa. Vaccines like RTS,S must be refrigerated until they are administered and can only be given by trained professionals, so local infrastructure and healthcare systems are often not adequately equipped. The affected countries would have to rely on financial support from developed countries, and this has tailed off in recent years. As Dr. Oliver Moldenhauer of aid organization *Médecins Sans Frontières* remarked in an interview with the German online magazine *Der Spiegel*: "Admittedly, significant progress has been made, but that should not result in cuts to malaria prevention and treatment. We need more mosquito nets and drugs."

To find out more, visit:
Roll Back Malaria: www.rbm.who.int

“Malaria is an absolutely controllable disease, and one can make tremendous progress in fighting it at very low cost.”

Jeffrey Sachs ▶▶

Making a difference

While sub-Saharan Africa bears the brunt of the malaria burden, other areas of the world are under similar strain. In some states in Brazil, particularly those located near the Amazon forest, malaria is the major public health problem. The small community of São José do Jabote, Uruará, is in one such malaria hotspot.

Here, the warm climate and abundant water supply offer ideal conditions for the malarial mosquito to survive, thrive and infect the human population. The consequences for São José do Jabote's men, women and children have been dire.

Four years ago, malaria was as rife as the common cold, with each person in São José do Jabote contracting the disease at least three times a year. School attendance had plummeted and, unsurprisingly, the community's educational objectives were under threat. It was here that BASF, in partnership with Foundation for Health Surveillance in Amazonas (FVS – AM), launched a study to assess the effectiveness of Interceptor®, BASF's long-lasting insecticidal net.

In late 2008, the project kicked off: Interceptor nets were placed in every house in São José do Jabote. Residents were also coached on how to use the nets and what they were for. The results were impressive. Just two years later, the incidence of malaria had fallen by 97%, with only one person in every 12 contracting the disease. The positive effects rippled throughout the community. Free from malaria, the children were finally able to regularly attend school – allowing the community to meet its literacy objectives in just two years. These effects typify one of the major targets of the U.N. Millennium Development Goals – namely, that a healthier, more educated population is key to sustainably support poverty reduction.

BASF is convinced that supporting and engaging in simple local projects can bring life-changing benefits. The results in São José do Jabote bear this out. ■



Left The introduction of Interceptor®, BASF's long-lasting insecticidal bed net, led to a 97% reduction in cases of malaria in São José do Jabote, Brazil. The entire community of São José do Jabote benefited, particularly young people who are most affected by malaria.



Left The São José do Jabote community in Brazil is located in the lower Amazonas region in the district of Uruará, on the left bank of Jatapú River.



One of the biggest advantages of the Interceptor® nets is that they can easily be installed by a single person. Residents in São José do Jabote received simple coaching on how to use the product, and could then set up nets in their homes themselves, without the need for any complicated tools, skills or help. This ease of use has helped Interceptor nets become widely accepted in the area.



Left There is no major road infrastructure in the region, thus river transport is the main form of travel. FVS – AM teams traveled monthly to São José do Jabote to monitor how the fight against malaria evolved. The results were astonishing: The rate of malaria fell from 3.52 cases per person in 2007 to only 0.12 cases per person in 2010.

Below Education is another key element of the initiative from BASF and FVS – AM: Schoolchildren color pictures of mosquitoes to learn more about the insect that caused 465 cases of malaria in 2007 among a population in São José do Jabote of just 132.

Right A nurse takes a blood sample from a São José do Jabote child. The blood will be tested for the presence of the *Plasmodium falciparum* parasite.

Below To successfully combat malaria, the villagers learned more about how to use and care for the Interceptor® bed nets. This included special education programs for São José do Jabote's children that helped them understand the importance of mosquito control.



Net value

How BASF's Interceptor® mosquito nets save lives



Above BASF's Interceptor® nets in action in Brazil.

Nearly 165 million mosquito nets made by different producers were supplied to malaria zones in 2010 – with around 145 million going to sub-Saharan Africa alone. The percentage of at-risk households owning at least one net has risen from 3% in 2000 to 50% in 2011. According to the World Health Organization (WHO), as long as there is no effective vaccine against malaria, mosquito nets will continue to be a decisive tool in malaria control.

To meet WHO recommendations, nets must last for three years and 20 washes and contain an insecticide that kills mosquitoes after brief contact – such as BASF's mosquito net Interceptor®. It is thus recommended by the WHO as a "long-lasting insecticide-treated net" – or LLIN.

The nets are most effective when used in combination with other malaria control products (see box on right). Dr. Egon Weimüller, Head of the Public Health business at BASF, explains that collaboration between the private sector and aid organizations is also essential: "For instance, we work very closely with aid organizations who distribute the nets as they are crucial in supporting the process on-site."

Making nets truly effective

While ordinary nets will keep mosquitoes at bay, they won't prevent them biting

through the mesh or flying on to find other unprotected victims. Not until the net has been treated with an insecticide can the cycle of malaria transmission be effectively disrupted.

Interceptor nets are coated with alpha-cypermethrin. Harmless to humans, this active ingredient had already been used in the BASF insecticide Fendona® before the company began research on Interceptor in 2004 at WHO's request. The biggest challenge was attaching the active ingredient to the net's synthetic fiber in such a way that the net would remain effective for at least three years and 20 washes. The solution was Interceptor's special odorless coating, which continues to protect against mosquitoes after multiple washes.

While LLINs like Interceptor have been a positive milestone in the fight against malaria, there are still challenges ahead. Widespread use of the active chemical agents can result in mosquitoes developing resistance. This can trigger a fatal cycle: If the insecticide fails to affect even a minimal proportion of mosquitoes due to natural resistance, these mosquitoes survive, reproduce and multiply while their contemporaries die off. In a worst-case scenario, the resistant mosquitoes could eventually become so numerous that the malaria infection rate increases again.

Breaking the cycle

It's possible to break this cycle by developing a new active agent – but at around \$200 million, development costs are high. So high, in fact, that the last time a new active agent for mosquito nets was introduced was 23 years ago. "Financial resources are limited, especially in the area of public health," explains Weimüller. Companies have to go through a costly process to gain WHO approval for their public health products; often, shortly after a product has been brought to market, copycat goods start to appear.

These circumvent the research costs, which inhibits development activities at research companies.

Developing a new solution

Despite the challenges, BASF still has a solution up its sleeve: the insecticide chlorfenapyr. The company is currently in the process of developing a next generation of malaria control products based on this active ingredient, which has already proven safe and effective in other BASF insecticides for crop protection and urban pest control – thus making it possible to accelerate development. In the fight against malaria, however, the insecticide marks an innovation: Whereas traditional insecticides affect structures of the mosquito's central nervous system, chlorfenapyr disrupts cell metabolism. Because it works differently, this insecticide will help stem malaria in areas of current insecticide resistance.

Introducing this insecticide into public health schemes still involves a lot of investment and work. BASF is working with the London School of Hygiene & Tropical Medicine (LSHTM) and the Innovative Vector Control Consortium (IVCC). While both institutes are responsible for lab testing and field studies, BASF is handling development, registration, approval and sales. Dr. Robert Sloss, Portfolio Manager for public health products at the IVCC, stresses: "New approaches that safeguard and expand the arsenal of active agents currently available are essential. That's the only way we are going to get a handle on the ever-increasing levels of resistance."

Initial tests have confirmed the effectiveness of the new active agent against insecticide-resistant mosquitoes. Weimüller says: "We also hope that this cooperation and the positive results will provide additional motivation for all parties involved in the fight against tropical diseases." ■

The science behind the innovation

The Interceptor® mosquito net by BASF remains effective against mosquitoes even after several years. So how does it work?



1. The net fibers are coated with a polymer binder combined with an insecticide. The binder attaches the active agent to the fiber in such a way that it remains evenly distributed across the surface for years.



2. The mosquito lands on the net.



3. Brief contact with the net is enough to seal the mosquito's fate.



4. A few minutes after contact, the stunned mosquito falls to the ground – this is called the 'knock down.' The insecticide has disrupted the structures in its central nervous system.



5. Almost all mosquitoes die within a few minutes.

BASF's contributions to fighting malaria

Our 5-Pillar Action Plan focuses not only on products designed to control the insects that disseminate disease, but also actively pursues collaborative partnerships and initiatives with the international public health community, as well as developing innovative solutions to help win the battle against malaria.



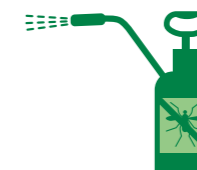
To find out more, visit: www.publichealth.basf.com

1 Interceptor® nets



Interceptor nets offer protection, especially at night, from mosquitoes that spread malaria. They are treated with Fendona®, an insecticide that kills mosquitoes on contact.

2 Fendona®



The insecticide Fendona is applied to interior residential walls by trained professionals. The mosquitoes die after touching the treated walls.

3 Abate®



Residential areas can be protected when standing water is treated with the larvicide Abate to prevent mosquito larvae from developing.

4 Partner organizations



BASF is a partner with various aid organizations that are trying to put an end to malaria and improve health systems in the affected countries.

5 New products



Mosquitoes are becoming immune to the existing active ingredients. BASF is therefore working on a new generation of products to combat malaria.

Signs of our times

Books and films often act as expressions of the major influences and trends shaping our world, as do the gadgets that increasingly accompany our lives. Signs of our times takes a look at some of these notable cultural and technological innovations.

A good read

Great books that raise an eyebrow, raise your heartbeat, or raise a smile.



Beyond Smart Cities: How Cities Network, Learn and Innovate

By Tim Campbell, out in early 2012

As an expert in several areas of urban planning and policy, and with a background in the World Bank, Tim Campbell turns his attention to 'Smart Cities' – urban areas that nurture learning and innovation. Drawing on case studies and research, he examines the mechanisms that influence how a city learns – and connects with the knowledge and expertise held within other cities. The book also looks at how cities build and manipulate relationships in urban environments. It puts specific focus on locations that have achieved significant transformation but have been largely overlooked in academic circles, including Amman, Barcelona, Bilbao and Seattle. *Beyond Smart Cities* is an illuminating insight into an important, contemporary phenomenon.



Sunrise on the Southbound Sleeper: A Second Telegraph Book of Great Railway Journeys

Edited by Michael Kerr, out now

Hot on the tracks of his bestselling anthology, *Last Call from the Dining Car*, Michael Kerr brings together a new collection of the best rail journeys from the pages of the U.K.'s *Daily and Sunday Telegraph*. It's just the ticket for armchair travelers looking for enthralling, life-changing and even death-defying rail adventures across the globe, with several scenic stop-offs through history along the way.

Ones to watch

The latest big-screen releases and must-see films.



Unknown

Director:

Jaume Collet-Serra
Starring: Diane Kruger,
Liam Neeson and
January Jones

While striving to bring a breed of genetically modified corn to the world that promises to solve the problem of global food shortages, Dr. Martin Harris (Liam Neeson) and his wife (January Jones) travel to Berlin to attend a conference. While there, a car crash puts Harris in a coma and he wakes only to discover that another man has taken over his life. When even his wife fails to recognize him, he enlists the help of taxi driver, Gina (Diane Kruger), to uncover his true identity.



Margaret

Writer and Director: Kenneth Lonergan
Starring: Anna Paquin,
Matt Damon
and Mark Ruffalo

Set in New York, a teenager (Anna Paquin) witnesses a bus accident in which a woman is killed. The legal proceedings which follow embroil the teen in a struggle with her own morality and an internal search for meaning.



Life in a day

Director: Kevin Macdonald

Kevin Macdonald has turned 80,000 hours of amateur YouTube video clips into a compelling, coherent and uncontrived snapshot in time. With all the footage shot on July 24, 2010, this remarkable film insightfully depicts what it's like to be alive from sunrise to sunset, all around the world.

Techno corner

Technology from the future, available today.

Intelligent packaging

Food waste is a growing problem, on a global scale. But BASF's OnVu® temperature monitors could help reduce wastage. These low-cost, easy-to-use indicators can be applied to food packaging to monitor the integrity of the cold chain. They feature a panel which changes color if the product has become inedible because it has not been kept sufficiently cold throughout storage and transport. This helps to keep all refrigerated products fresh – which could reduce unnecessary waste in the future. So you should have more food in your fridge, and less in your trash.



3D printers

A revolution is taking place from every angle – not just in the cinema, but in studios and even in the home. 3D printing is a recent development that enables items that would previously have been built by hand to be 'printed' by building up layer upon layer of a specific substance. The technology lets designers turn drawings almost instantly into prototype models. And, with 3D printers now available for domestic use, it's turning everyday consumers into manufacturers.



iRobot Roomba 770 – vacuum cleaner

Automated vacuum cleaners have been around for a while, but the Roomba 770 is top of its class. With highly evolved sensors, it navigates even complicated room layouts without crashing or damaging anything. A single spinning brush, large battery and even larger capacity make it a true labor-saving device.

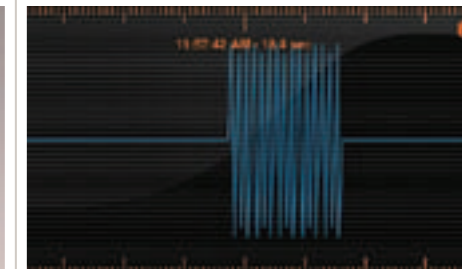


To find out more, visit:
www.guardian.co.uk/technology
www.livescience.com



Great apps

Fun and handy apps that help make life that bit easier.



Sleep Talk Recorder

How can you ever really know if you talk in your sleep? The Sleep Talk Recorder by Mad In Sweden is a clever app that monitors you while you're asleep and activates a recording function when it hears you mutter.

Gas Cash-Ometer

To find out how much a car trip costs you in fuel, simply enter the mileage, the amount of fuel used and cost per liter or gallon – then let Gas Cash-Ometer do the rest. This handy app also has functions that allow you to calculate the monthly and yearly cost of a regular commute.



Pocket ultrasound imaging

Why have the patient come to the scanner, when the scanner can go to them? The MobiUS SP1 is the world's first ultrasound imaging system that works on a smartphone. It allows doctors to monitor pregnancies and check on a patient's internal organs while on the move around the ward. This ingenious device could revolutionize healthcare for the 70% of the global population who do not have access to ultrasound.



Feeding the world

In 2050, more than nine billion people will live on Earth. How do you satisfy the demands of the growing population? Access to clean water is becoming increasingly important, and the growing world population obviously needs more food. Simply turning more land over to agriculture is not viable: Besides its environmental impact, the amount of available land is limited. The only realistic option seems to be an increase of agricultural productivity, and here's where some argue plant biotechnology can play an important role.

The method behind plant biotechnology is ancient: We've been using microorganisms to create everyday products like yogurt, vinegar and wine for millennia, and we have been selecting and breeding plants for many centuries. But while such traditional applications of plant biotechnology are accepted without question, its more modern forms have proven controversial. Nowadays, plant biotechnology takes breeding methods a step further by modifying the genetic material of plants and bacteria more quickly and in a more scientifically-controlled way.

Supporters argue that plant biotechnology will help increase yields and mitigate the impact of climate change on production by developing drought-resistant crops, for example. However, critics argue that its potential contribution is, at best, exaggerated, and, at worst, counter-productive and harmful to nature. They also suggest that there are other, more sustainable ways to increase yields. So who is right? We asked Peter Brabeck-Letmathe, Chairman of the Board of Directors of Nestlé, and Dr. Hans Rudolf Herren, Vice Chairman of the International Assessment of Agricultural Science and Technology for Development (IAASTD), to present the cases for and against.



Peter Brabeck-Letmathe

is an Austrian manager. He holds a degree in Economics from the University of World Trade in Vienna and joined the Nestlé Group's operating company in Austria in 1968. There he started as a salesman, later becoming a specialist for new products. After working in different positions in South America, he was appointed Chief Executive Officer of the world's leading food company in 1997. In 2005, he was also elected Chairman of the Board of Directors of Nestlé S.A. When handing over the office of CEO in 2008, he remained Chairman of the Board.

Creating Chemistry: In 2050, around 9 billion people will live on Earth. Yet resources like energy, water and food are scarce even today. What challenges will result from this?

Peter Brabeck-Letmathe: The increasing world population – coupled with the use of resources – is one of the biggest challenges we have to face at present. In the coming years and decades, our demographic development will reach between nine billion and ten billion people, and the world's resources are after all limited; yet we can hardly call our current treatment of them a sustainable use of resources.

We especially have to rethink our approach to the most important resource – water. It is already a big enough problem with seven billion people, in that we use more water than we can replace. We are “overusing” water in the amount of 300 cubic kilometers per year – and nature is paying for it.

The increasing scarcity of water subsequently leads to ever-greater problems in the food supply. This development is alarming. Every second, the world population increases by four people; at the same time, 0.3 hectares of farmland are lost. And after an intermittent decline, the number of starving people in the world has once again increased to more than a billion people since 2008. This is unacceptable.

How can we manage to take care of the world population both now and in the future using the resources currently available to us?

One of the biggest problems right now is the high price of food. We therefore need a policy that clearly states: “No

food for fuel.” The crazy thing is that politics has created this senseless demand for biofuels, and thus the additional scarcity in the food supply itself. This is one of the main reasons for the immense price increases and unrest in the developing world.

Secondly, investment in agriculture must be strengthened. This includes genetic engineering. In the past ten years, the growth of productivity in the agricultural sector has lagged behind the growth of the world population, especially as a result of technophobia.

Thirdly, the infrastructure for processing, transporting and storing food must be improved and the squandering of resources through today's mountains of waste must be reduced. In developing countries, around half of all food supplies rot in the course of the whole supply chain. Even in Germany, more than 10 million metric tons of edible food land in the garbage.

Furthermore, we need secure free markets instead of random political decisions where, for example, countries suddenly limit the export of wheat or sugar.

What contribution can plant biotechnology make to feeding a growing world population?

On a global level, we simply cannot do without genetic engineering. In a way, I do understand the attitude of some portions of the German populace. Food is in no way scarce there, and farmers are paid even if they don't cultivate their fields. But the situation is different in the rest of the world as a result of the population explosion. We must double agricultural production by 2050; however, we cannot expand acreage indefinitely. Therefore, we have

to develop plants that offer higher yields and use less water. To do this, we need genetic engineering.

A large part of the European population rejects plant biotechnology – and the application of genetically modified plants and seeds is strictly regulated. To what extent does this have consequences for other countries, and how do you rate these effects?

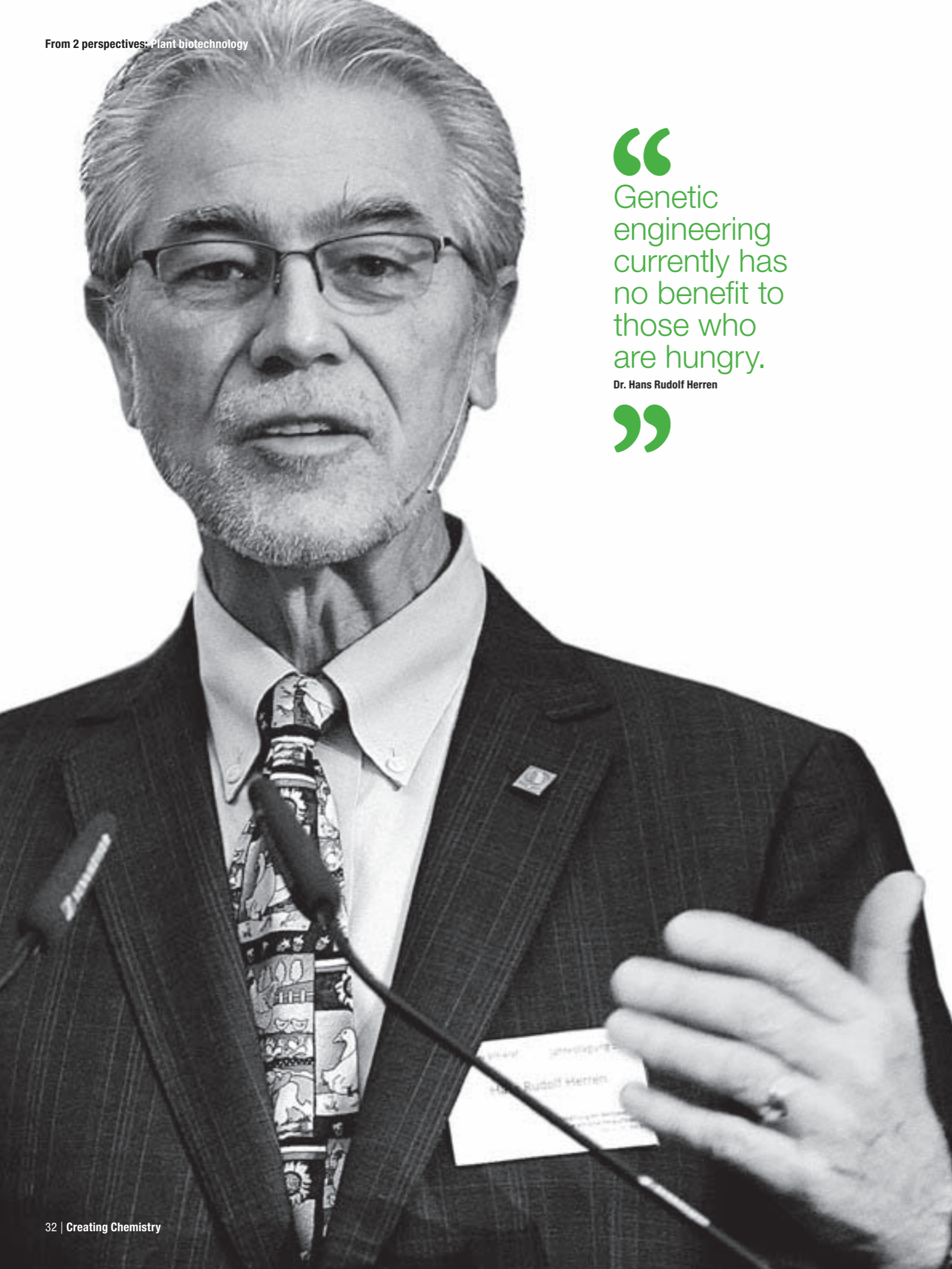
A large dose of romanticism plays a role here, not only in Germany but also in other European countries. Genetically modified products haven't killed anyone yet, but as recent cases in Germany have shown, organic products have. Of course we can never exclude the possibility of residual risks, but when penicillin was discovered, that was also a risky venture. Genetic engineering was invented in Europe. Instead of being proud of this, we disdain it and leave the field to the Americans, Chinese and Brazilians.

How should the consumer be informed that a product has been genetically modified?

That depends on each individual country and its rules and regulations. Furthermore, it has to do with consumer attitudes toward genetically modified products. In the United States, for example, genetic engineering is no big deal. People who vacation in California and Florida will automatically eat genetically modified food. In Germany, the majority of consumers refuse these products, which is why we don't offer them. If this were the case, then the information would certainly be visible for the consumer on the packaging label. ■

“
The increasing scarcity of water subsequently leads to ever-greater problems in the food supply. This development is alarming.
”

Peter Brabeck-Letmathe



“Genetic engineering currently has no benefit to those who are hungry.”

Dr. Hans Rudolf Herren

Creating Chemistry: In 2050 there will be more than 9 billion people living on Earth – and there is already a shortage of important resources such as energy, water and food today. What are the main causes of this?

Dr. Hans Rudolf Herren: Humankind is not living sustainably. Instead of living off the interest that the Earth's natural resources provide, we are eating away at the capital. On a global average, the ecological footprint of every inhabitant of this planet today is 1.5 times larger than it should be; in the rich industrialized countries, it is nearly 3.5 times too big.

Why are people acting like this? One reason is certainly that the true costs are not transparent. For those who have access to resources today, consumption is cheaper than sustainable use. Poverty is also a factor preventing sustainable action: A person who is fighting to survive today cannot be expected to think about the future as well. The agricultural sector is also overexploiting its resources. It is responsible for 70% of global fresh water consumption. Inappropriate land use has led to the degradation of 1.9 billion hectares of the 5 billion hectares of agricultural land available worldwide. Furthermore, three quarters of agricultural biodiversity has been lost over the past 50 years. These problems are also a result of mistakes made in agricultural policy.

For too long there has been unilateral support of industrialized and reductionist agriculture which concentrates on a few high-yield crops that require a lot of fertilizer, water and pesticides to get the maximum return from the soil in the short term – without taking into consideration the ecological consequences.

How will we manage to secure the wellbeing of the growing world population using our existing resources?

The world needs a revolution in resource efficiency that reflects ecological realities. The agricultural sector is basically able to feed more than 9 billion people on Earth. Current harvests would be sufficient to feed another 2.5 billion people if we didn't let half of them go to waste.

We need ecological, multifunctional agriculture that strives for yields that are sustainably feasible rather than the highest yields; it must also maintain and nurture its foundations – the natural soil fertility and biodiversity. We need to regenerate degraded soils, and

compost will play an important role in this. Better irrigation technology such as drip irrigation enables yields to rise by up to 100% with a 40% to 80% reduction in water consumption.

Eco-efficiency is just one element – the other key word is “sufficiency.” If rising standards of living mean another 3 billion to 4 billion people eat as much meat as we do today in Europe and the United States, our resources will not be sufficient.

For its supporters, plant biotechnology is a key means of feeding the growing world population. You say organic farming is an alternative. But would that not require significantly more cropland than is available?

That is not true. The necessary changeover could lead to a slight decline in production in industrialized countries, but it would be bearable. In fact, it would actually reduce the dumping on agricultural markets in developing countries which results from these industrial surpluses.

On the other hand, in the small-scale agriculture practiced in developing countries – where increases are needed – there is also still great potential for production growth with organic methods. Numerous projects in the tropics and subtropics have shown that with good organic farming practices yields can be increased by 50% to 150%. In these cases, the long-term production growth is especially significant because the soils become more fertile sustainably with such farming methods. Another important positive outcome is that the system becomes more resilient to the effects of climate change and increasingly extreme weather conditions.

Is it not possible to achieve exactly the same effects with plant biotechnology?

The term ‘plant biotechnology’ can mean a lot of things, but what we're debating here is genetic engineering. In my opinion, it's not an appropriate means of solving the global food problem. An evaluation of numerous studies on this subject found that it currently has no benefit to those who are hungry. Improving food security was also not the aim of the genetically modified crops available today, although there have been some sporadic yield increases which depended strongly on the location, weather and type of plant.

One main focus has been the development of herbicide resistance to

enable farmers to spray total herbicides without damaging their crops. The other focus has been on adding genes that encode the production of a toxin to combat harmful insects. However, there are already proven methods to solve weed and pest problems in a sustainable way without any ongoing costs, for example, organic pest control or the practical and preventive design of agricultural ecosystems.

Furthermore, genetically modified seeds can only be used once and are far too expensive for most small-scale farmers. The large-scale farmers in the United States are already complaining about the high licensing fees for genetically modified crops. Even in the medium term, genetic engineering will do very little to help improve the world's food security.

What measures would you rather see politicians introduce in order to address energy, water and food shortages?

The strategic policy shift called for in the IAASTD (International Assessment of Agricultural Knowledge, Science and Technology for Development) report on global agriculture needs to be implemented now. This will primarily mean empowering small-scale farmers. The world's 525 million small farms are responsible for 70% of global food production. These are capable of feeding people in developing countries – without any need to overexploit the soils, clear forests or destroy other valuable ecosystems.

But they will need assistance and an appropriate policy framework in order to achieve this. The United Nations Environment Programme's (UNEP) Green Economy Report therefore calls for ongoing investments of 2% of global economic output in order to initiate the transition to a low-carbon, resource-efficient global economy.

If you weigh the risks and opportunities of plant biotechnology, which side do you think is more significant?

The risk side. In my opinion, the risks are mainly that the use of genetic engineering in agriculture generally entrenches farming systems that are unsustainable because they are based largely on external energy sources – artificial fertilizer and pesticides – and monocultures. The cultivation of genetically modified varieties that produce toxins to combat harmful insects is also problematic because it invariably leads to the

Dr. Hans Rudolf Herren

is a Swiss insect research scientist, and agriculture and development expert. After studying agricultural science and entomology in Zurich and Berkeley, he lived and researched in Africa for about 30 years. In the 1980s he helped save an endangered manioc crop, an important food staple in Africa, by distributing a natural enemy of the vermin that were destroying the plants. For that he was awarded with the World Food Prize in 1995. He is Vice Chairman of the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD) and founder of the foundation BioVision, which is concerned with the sustainable improvement of the living conditions in Africa and the use of ecological methods.

pests developing resistance to the questionable biological insecticide.

In terms of weed control, this technology has also led to the development of resistance, so now in many countries farmers must resort to using banned stronger “poisons.” We are therefore back to the catch-22 situation we had with pesticide use 20 years ago, and I have the impression that we haven't learned anything, we just continue to try and combat the symptoms. I believe the prospects for this technology in agriculture are very limited with regard to sufficient and safe food supplies. Furthermore, it hampers systems thinking for holistic solutions.

How should consumers be informed that a product is genetically modified?

I think it's obvious that it should be obligatory to declare whether food contains genetically modified products, not least because every purchase is a political decision. Today there are definitely not enough long-term scientific studies on genetically modified plants and their effects on our environment and human health. Consumers such as myself want to know what methods of production we are supporting with our purchases. The best solution would be an easily visible label for all genetically modified products. If the manufacturers are as convinced of these products' quality as they claim in the political debates, then they should use this added value as a selling point and put a seal on the packaging. ■

We need a change of perspective

Dr. Stefan Marciniowski believes it will be possible to feed the world's growing population – if we use innovations to develop sustainable agriculture.

Without a doubt we are facing major challenges at the beginning of the 21st century: The world population recently surpassed 7 billion and by 2050 there will be more than 9 billion people living on this planet. In emerging markets, the standard of living is rising rapidly, leading to brisk growth in the consumption of agricultural commodities.

Are we equipped to meet the challenges this will mean for agriculture while also dealing with climate change and protecting nature? The prevailing view in Europe right now is skeptical. There is often a focus on problems, both real and imagined, that exist or could

worsen as we tackle these challenges. We have to take these concerns seriously and address them. But fear limits us and prevents us from moving forward. To overcome these challenges, we will need to be optimistic, bold and creative. We need a change of perspective at all levels of society and a clear commitment to sustainable innovation.

The progress in agriculture alone over the past 50 years should serve as our motivation. Under the "Green Revolution" sparked by Norman Borlaug, yields have grown dramatically since the 1960s thanks to new methods of breeding, growing and modern crop protection,

securing the basic nourishment of millions of people. Nobody wants to reverse these accomplishments as it would mean hardship for so many. In addition, new problems have arisen, such as depleted soils, over-fertilization and soil erosion, which also need to be solved. But we have also been learning how to better tackle these challenges: Thanks to the advancements in science and agriculture, there are continuous innovations in farming – not least because companies such as BASF have an inherent interest in developing solutions for efficient agriculture which conserve resources and the environment.

Below Technological advances in agricultural methods, such as irrigation, are designed to help produce more food for our growing population.



“Fear limits us and prevents us from moving forward. To overcome these challenges, we will need to be optimistic, bold and creative.”

Dr. Stefan Marciniowski



The history of humankind is strongly intertwined with the history of agriculture. We will need to lift agriculture to the next level of a sustainably-oriented food supply and, at the same time, supply renewable raw materials and bioenergy. There are many possible ways to accomplish this.

There is no question that we have to use our fresh water reserves wisely. However, we should also keep in mind that on our "blue planet," it is not that the quantities of water are scarce, but rather that infrastructure is inadequate to make clean water sufficiently available everywhere. Once again, it is a matter of perspective: We will be more successful at finding ways to improve supply if we focus on creating positive change, not just trying to adapt to shortage situations. We should also recognize and take advantage of opportunities that will allow us to overcome existing and anticipated scarcity.

BASF believes plant biotechnology is one of these opportunities. It isn't the solution for everything, but this modern bioscience is a powerful tool to improve global food supplies. Plant biotechnology overcomes the limitations of conventional breeding methods, and enables farmers to increase yields and conserve resources. Plant biotechnology is already bringing socioeconomic successes – in developed as well as in emerging countries. It can also help to further improve environmental protection in the agriculture sector.

With BASF Plant Science, we have been actively researching these opportunities since 1998. We are convinced that we are making an important contribution to the sustainability of global agriculture – especially because since the first release experiments 25 years ago and numerous safety studies, there has not been any substantiated evidence that this is a "risk technology." On the contrary, the continuous growth in cultivation figures since the first commercialization in 1996 sends a clear message: In 2010 alone, 15.4 million farmers in 29 countries cultivated transgenic crops on a total of 148 million hectares of land. This represents around 10% of farmland worldwide and is roughly equivalent to the areas of Germany, France and Spain combined.

Plant biotechnology is a valuable advancement in plant breeding as well as a complement to modern crop protection processes and agronomic practices. It thus represents another step forward in the history of agriculture. At BASF, we want to take advantage of this opportunity. ■



To find out more, visit: www.basf.com/biotechnology

Dr. Stefan Marciniowski Member of the Board of Executive Directors, BASF SE

Dr. Stefan Marciniowski assumed his current position with BASF SE in 1997. Prior to this, Marciniowski had been President of the Plastic Foams & Reaction Resins division since 1995.

Marciniowski started his career with BASF in 1979 in biotechnological research. In 1986, he became Staff to the Chairman of the Board of Executive Directors and in 1988, Senior Vice President of the Public Relations department. He transferred to Brazil in 1992, as Executive Vice President of BASF Brasileira S.A. in São Paulo.

Marciniowski was born in Stuttgart, Germany, in 1953. From 1971 until 1976 he studied chemistry at the Universities of Stuttgart and Freiburg, Germany. He received his degree in chemistry from the University of Freiburg in 1976. Marciniowski holds a doctorate from the University of Freiburg, which he obtained at the institute of the biochemist Professor Hans Grisebach in 1978. Marciniowski was then a research associate there until 1979.

The load ahead

The battle against congestion and rising emissions

The value of global merchandise freight exports nearly tripled in the last decade, from \$5.4 trillion to \$16 trillion. Despite the impact of the global financial crisis, that growth is expected to continue over the next 10 years. Faced with the need to address the impact that the international movement of goods has on climate change, multinational companies such as BASF are changing the way they manage their logistics.

For more than 100 years, the Massachusetts Institute of Technology (MIT) has led research and innovation across science, technology and business. In 2011, BASF established a partnership with the Center for Transportation & Logistics (CTL), one of the world's leading logistics research institutes based at MIT. Together, they hope to find new, sustainable solutions that are crucial for future growth.

The causes for concern

More people, more products, more emissions

The American distribution system moves about 110 kilograms of freight per U.S. citizen per day. But, according to Joseph C. Szabo, head of the Federal Railroad Administration in Washington, D.C., increasing consumption and a growing population are set to drive trade and therefore freight levels even higher.

"By 2050," he said in May 2011, "the American population is expected to grow by more than 100 million people. So do the math: 40 metric tons [per year] times another 100 million people is another 4 billion metric tons of freight."

And that's just in the United States. Global figures are hard to predict but given that worldwide trade has increased twentyfold since 1950, even conservative estimates make for eye-watering sums.

The rise of modular manufacturing

It is not, however, just a question of more people consuming more products. A second important trend behind the figures is the rise of modular manufacturing. Where possible, manufacturers divide products into smaller parts that can be independently created and then used in a number of different items. Cars, computers and even high-rise buildings are often made in this way. However, as the different components are increasingly outsourced to different specialists, more items have to be shipped around. In addition, the huge rise in e-commerce is putting further strain on domestic delivery networks.

Megacities, mega challenges

The situation is even more complicated in the world's fastest growing markets, such as Brazil, India and China. Here, the rapid growth of megacities creates unique challenges. Manufacturing and retail in these economies tends to be more fragmented, with a larger number of companies distributing products to a larger number of outlets. With space at a premium, inventory is generally lower, which in turn leads to more deliveries from smaller trucks.

On top of that, poor infrastructure, less efficient planning and relatively unsophisticated IT networks all mean that distribution is slower and, critically, more difficult to track and measure.

But poor infrastructure is not just limited to the developing and newly industrialized world. As politicians battle with deficits right across Europe, parts of Asia and North and South America, investment is suffering. The American Society of Civil Engineers, for example, estimates that \$2.2 trillion is required in the next five years to lift U.S. infrastructure to an adequate level.

In addition to the overall increase in freight and insufficient infrastructure, there is also the problem of climate change. In 2009, the transport sector accounted for 15% of overall greenhouse gas emissions and, in the European Union at least, tough targets are already in place for the transport sector, forcing manufacturers, retailers and logistics companies to become more carbon sensitive.

The question is: What can be done to ease the flow?

Container freight at Shanghai harbor. World trade has increased twentyfold since 1950 and container freight will continue to soar over the coming decade.



Logistical solutions from the Massachusetts Institute of Technology

Ask the world's logistics experts

Specializing in science, technology and other areas of academia that will best serve the world in the 21st century, the **Massachusetts Institute of Technology (MIT)** is one of the world's leading universities. MIT graduates are credited with inventing everything from condensed soup and the wind tunnel to hypertext and the Global Positioning System. Partnering with over 40 of the world's biggest and most demanding companies, **MIT's Center for Transportation & Logistics (CTL)** coordinates extensive research on transportation system planning, operations and management. They have been a global leader in supply chain management education and research for 40 years and they now have affiliates in South America, Southeast Asia and Europe.

Given the combination of conflicting factors, some argue that the outlook for logistics is bleak. The experts at the MIT Center for Transportation and Logistics (CTL), however, paint a different picture. They believe that three ongoing trends will smooth the path of distribution over the next 10 years: increasing efficiency, slowing the supply chain and improving distribution with better data. In order to recognize such trends and to find answers to optimize them, the CTL teams up with leading corporate partners. BASF joined the community in 2011. "The cooperation aims to achieve joint research and strategic development in supply chain management. BASF directly benefits from interaction with MIT researchers on current industry issues and privileged access to symposia series, student recruiting and communications programs," says Dr. Robert Blackburn, President Information Services and Supply Chain at BASF.

Tackle inefficiency

As fuel, and therefore transport, has been relatively cheap for the last 50 years, a number of inefficiencies have infiltrated our distribution networks.

One of the oldest problems distributors face, for example, is how to find cargo for their return trip home once a delivery has been made. According to a 2009 report by the World Economic Forum (WEF), 24% of all freight vehicles in the European Union run empty – while in the United States, it's more than 25%. New websites that link shippers and truckers with spare capacity in both Europe and the United States are already making big efficiencies.

The retailer Macy's has 450 stores across the United States and is one of many shippers to use www.emptymiles.org. By finding another shipper to use a truck on a return journey, they can save about \$25,000 on certain routes, according to Bill Connell, Macy's Senior Vice President for transportation and logistics. And as conventional fuel costs continue to rise, so will the savings.

Tackle climate change

In fact, says CTL Executive Director Chris Caplice, without the big savings to be made by reducing fuel use, customer pressure and regulation would not be enough to get most businesses to cut CO₂ emissions. "We are very fortunate that emissions reduction cuts costs. It's really a case of 'green by luck' rather than by intent," he observes.

The 2009 WEF report concludes that some 124 million metric tons of CO₂ emissions could be saved each year by improving network efficiency. CTL plays a key role in finding and eliminating those inefficiencies.

In a recent project with a major European electronics manufacturer, for example, customer orders were consolidated and dispatched in full pallets, as opposed to sending them out every three hours, irrespective of the quantity. As a result

they avoided up to 13% of all logistics emissions. Interestingly, only 7% of those savings came from transportation efficiencies. 93% came from the reduction in cardboard packaging and wood pallets. There were also considerable cost savings.

New fuels, new designs

More efficient design and switching to alternative fuels are also helping companies go green and save more money. Maersk, for example, one of the world's biggest sea freight companies, cut emissions by 13% in three years. And by optimizing engines, reducing hull friction, rethinking propeller design and a number of other measures, they've been able to cut fuel consumption by up to 20%. On top of that, new waste heat recovery systems fitted to their latest ships can reduce fuel consumption by 8% to 10% under the right conditions.

It's hoped that next-generation ships could make even more difference. The zero-emission concept vessel *Orcelle*, developed by Wallenius Wilhelmsen Logistics and Toyota, for example, is designed to use wind, solar and wave energy. And, thanks to its unique five-hulled design, the ship can carry 3,000 more metric tons of cargo than one of today's ships. As a concept vessel, it's unlikely to be built, but the research could easily be incorporated into new ships.

Slow the supply chain, ease congestion

But, ask business people all over the world, what else can we do today?

Once some of the inefficiencies have been ironed out, it might appear that there are only two options: reduce the quantity of freight or improve the infrastructure. Given that consumers, business and government all want trade to grow, the first is clearly not viable. And given the lack of funding available and the congested state of existing networks, the latter is a huge challenge.

The answer therefore, according to CTL's Caplice, is to slow down the supply chain. By reducing the speed of delivery, he says, businesses can create space in crowded networks as well as cutting emissions and keeping costs the same, or even decreasing them.

By switching from trucks to a new rail line, for example, the retailer Walmart was able to improve costs on apple, pear and onion shipments from Washington State in the Pacific Northwest, to Rotterdam, New York, in the east. Although delivery time increased by one to two days and there were some rises in inventory costs, these were offset by a reduction of almost 50% in CO₂ emissions and an 11% reduction in costs.

Similarly, General Electric recently calculated that the airfreighting of 10% of their wind turbine products to China was contributing 40% of all of their airfreighting-related CO₂ emissions. The company quickly switched to sea transport, resulting in a substantial reduction in emissions.

“We estimate there were 5 billion mobile subscription holders worldwide in 2010. With the data those phones can provide, we can work out how to get freight from A to B much more effectively.”

Jhonatan Rotberg, Director of MIT's NextLab

”

Better data, better distribution

Yet, as Deutsche Post DHL pointed out in a recent report, logistics today is as much about the flow of information as it is about the flow of goods. Changes in IT, particularly the explosion in sophisticated handheld devices, have made distribution networks much more transparent, helping everyone plan more effectively. MIT's NextLab is a leader in this field, using smartphones to develop solutions for global problems not just in logistics but in health and education as well. "We estimate there were 5 billion mobile subscription holders worldwide in 2010," says NextLab Director Jhonatan Rotberg. "With the data those phones can provide, we can work out how to get freight from A to B much more effectively."

This is especially true in emerging markets where relatively cheap smartphones are now having a big impact. Working with CTL, Estafeta (one of Mexico's largest logistics companies) has launched

a new mobile platform which allows it to communicate directly with taxi drivers all over Mexico City, so that they can deliver urgent – and lucrative – packages.

"Previously, Estafeta had to ring individual taxi stands to see who was free," explains Rotberg. "It takes a lot of time and it's often inaccurate. Just because you're not at a stand, it doesn't mean you're busy."

Final testing is now underway and thanks to almost real-time data, Estafeta can monitor availability to create customized delivery routes as and when needed, as well as track deliveries and maintain records.

In the future, as both customers and consumers share more and more relevant data with both shippers and distributors, it will be possible to measure and adapt logistics networks increasingly accurately – at least for those companies who show they can be trusted.

"Visibility must always balance privacy needs," says Rotberg. "But where it does, increased transparency and close cooperation will be a major factor in helping to ease the flow of freight in the next 10 years." ■

The numbers

15%

15% of overall greenhouse gas emissions came from the transport sector in 2009.

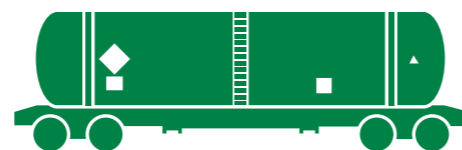
45%

CO₂ emissions from transport grew by 45% between 1990 and 2007.

40%

A 40% growth in CO₂ emissions from the transport sector is anticipated between 2007 and 2030.

Source: International Transport Forum, *Reducing Transport Greenhouse Gas Emissions: Trends & Data 2010*



Rail -27%



Road +48%



International shipping +63%



International aviation +76%

Freight: the environmental cost

Increase in CO₂ emissions by mode of transport 1990 – 2008

Source: International Transport Forum, *Key Transport and Greenhouse Gas Indicators by Country*

The long-term solution

What will have the biggest impact on logistics in the next 10 to 20 years?

According to Chris Caplice, Executive Director at the Center for Transportation & Logistics, two technologies – both being researched at MIT – will fundamentally change distribution.

3D printing

3D printing is a new form of manufacturing. It allows increasingly large components to be produced by laying down layer upon layer of the relevant raw material such as glass, plastic, ceramic or metal. In one process, metal is deposited in powdered form and fused together using a laser. Peter Schmitt, a PhD student at MIT, has successfully 'printed' a working grandfather clock.

Aerospace components, jewelry, car panels and even bicycle frames can now be 'custom printed' one at a time at low cost, thus eroding the hold that mass production currently has on manufacturing. And without mass production, cheap labor is no longer the decisive factor and there's no need to have products made thousands of miles from where they

are consumed. Furthermore, as the process uses computer-assisted design (CAD), it's simple to send custom data and instructions either directly to a customer's printer or, for complex items, to a specialist printing company located nearby.

The artificial leaf

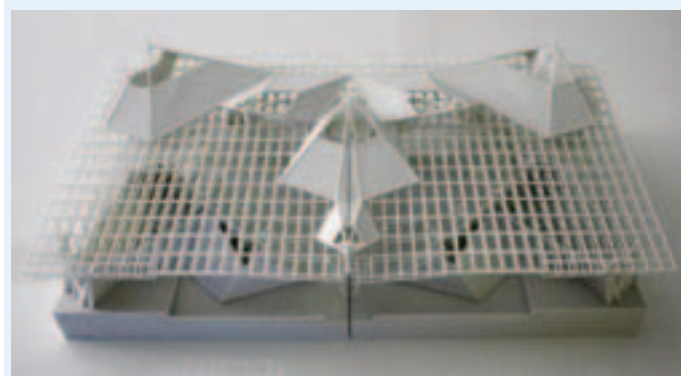
MIT has played a more important role in the second technological advance. Scientists at the institute have recently developed a next-generation solar panel dubbed 'the artificial leaf.' Floating in a tank of water, it mimics the workings of a real leaf using sunlight to split water into hydrogen and oxygen. The former is captured and can then be used in fuel cells to generate electricity.

"In one hour, more energy from the sun strikes the Earth than all the energy consumed by humans in a year," says MIT professor Daniel Nocera, and asks: "Why don't we make more use of it?"

Up to 10 times more efficient at carrying out photosynthesis than a natural leaf, it's hoped the artificial leaf will play a big part in further decentralizing our manufacturing networks and eliminating the need for shipping fuels around our planet.

"Our goal is to make each home its own power station" said Nocera. ■

BELOW 3D printers can create physical objects from CAD data.



The road ahead: Logistic challenges at BASF

Dr. Georg Wellinghoff, Senior Vice President Regional Procurement Europe, tells us about the distribution challenges BASF is facing and how the company is already dealing with them.

BASF has subsidiaries in more than 80 countries and supplies products to a large number of business partners in nearly every part of the world. To ensure that all the products the company produces are delivered safely and on time, the company uses as many as 1,500 different logistics partners worldwide. It has established rules and measures for transporting goods safely worldwide.



“By enabling more freight to be switched from road to rail, annual CO₂ savings in logistics will increase by 25%.”

Dr. Georg Wellinghoff, Senior Vice President Regional Procurement Europe



What are the biggest challenges for tomorrow?

Our overall aim in logistics is to ensure reliable supply to our customers while keeping a high level of efficiency. BASF's product portfolio will shift to more downstream products, so we're moving away from bulk logistics to smaller lot sizes. In turn, that requires greater flexibility.

So you'll be working more closely with your logistics partners?

That's right. We'll be working more closely, and probably with fewer suppliers. And we will integrate our processes. For example, we already have Electronic Data Interchange (EDI) connections with several of our logistics providers. That means we can regularly exchange planning and transportation data. This has to be expanded.

But what about congestion and poor infrastructure? How is that affecting you?

It's tough. In the next 10 to 15 years, freight volume is estimated to increase by 60% to 70%. Yet, there is no guarantee of sufficient public investment to avoid congestion. So we may have to move stock closer to our customers in order to ensure good service. But that means using more warehouses and increasing inventory levels.

And you're switching freight from road to rail, too?

Yes, that reduces our exposure to road congestion. In addition, we are testing rail transportation as an alternative transportation mode for selected products from Europe to Asia, to reduce lead times. We recently made the first shipments of hexamethylenediamine (HMD) to Shanghai by train. It's classified as a dangerous good. The route goes from Antwerp via Poland, Ukraine, Siberia and Mongolia to Shanghai. It took a great deal of planning to make sure the right safety precautions were in place, but as one of the first companies to do this, we are leading the way.

What about sustainable logistics in general? What are the challenges there?

The topic of sustainable logistics is getting more and more attention. The recent focus is very much on logistics-related emissions. Our approach to this is to first create transparency. We gather data from all over the world on volume, distance and transportation mode (train, for example, or inland waterway) and derive the amount of CO₂ emissions from that via a certified calculation model. But if we talk about sustainability, we should not only consider emissions.

In 2012, we will have our first set of workable key performance indicators considering environmental, economic and societal aspects.

But you've already made some big cuts in logistics-related emissions?

Yes, that's right. Switching from road to rail transport at our production sites in Ludwigshafen, Schwarzheide and Antwerp has already reduced emissions considerably. And in 2012, we will finish the expansion of the Ludwigshafen terminal. By enabling more freight to be switched from road to rail, annual CO₂ savings in logistics will increase by 25% to about 100,000 metric tons.

Are there any other challenges on the horizon?

The financial crisis has caused unprecedented volatility in freight volume in the last three years, especially at sea. Shipping companies try to optimize operations, routes are cut and lead times are changed at short notice. This has been hard for us. What we need are closer partnerships, alongside new operating models, in order to safeguard service levels.

We've still got some way to go in all these areas but, for me, that's the challenge. ■



To find out more, visit:
<http://ctl.mit.edu>
www.basf.com/future/climate

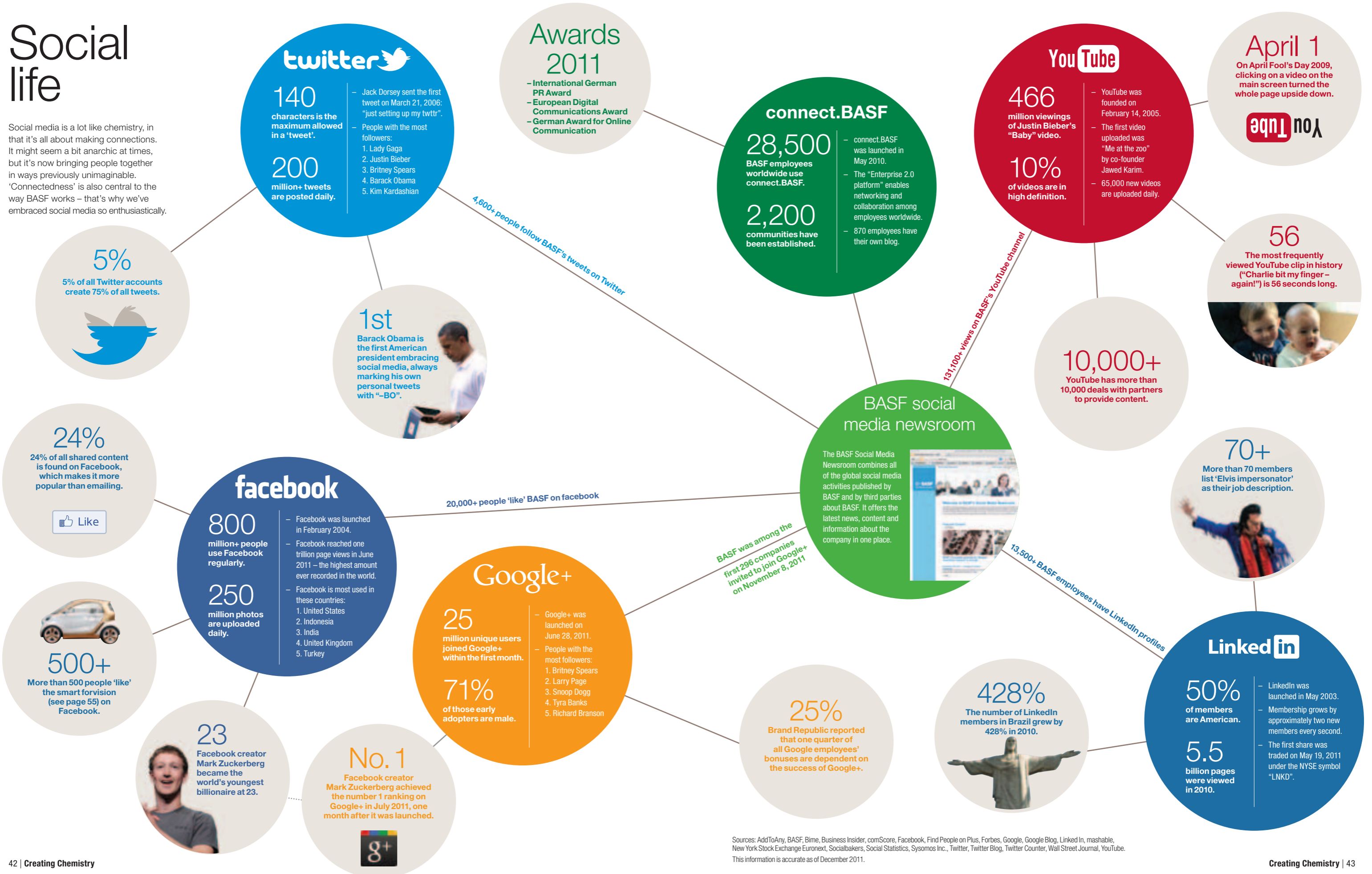


Above & right Intermodal transportation terminals reduce emissions: When shipments are transported by rail instead of by road, the carbon dioxide (CO₂) emissions from freight transport can be reduced by up to 65%. BASF takes advantage of this potential particularly at the large Verbund sites Ludwigshafen (blue terminal) and Antwerp (red terminal).



Social life

Social media is a lot like chemistry, in that it's all about making connections. It might seem a bit anarchic at times, but it's now bringing people together in ways previously unimaginable. 'Connectedness' is also central to the way BASF works – that's why we've embraced social media so enthusiastically.



Sources: AddToAny, BASF, Bime, Business Insider, comScore, Facebook, Find People on Plus, Forbes, Google, Google Blog, LinkedIn, mashable, New York Stock Exchange Euronext, Socialbakers, Social Statistics, Sysomos Inc., Twitter, Twitter Blog, Twitter Counter, Wall Street Journal, YouTube. This information is accurate as of December 2011.

The Shard, London: At 310 meters, this futuristic mixed-use tower will be the tallest building in Western Europe when completed in 2012. The construction of the 13 meter deep, three-floor basement box involved a record-breaking concrete pour, where 5,480 cubic meters of concrete was poured in 35 hours over one weekend, using BASF's concrete admixtures Glenium® and Pozzolith®. The speed of pour ensured minimal disruption and faster working, without sacrificing performance. One further advantage of the admixture: The concrete can be pumped to an altitude of 300 meters without problems.

Our Urban future

New technologies are creating sustainable buildings, delivering both commercial success and environmental and social benefits.

Humanity has hit a milestone: There are now more of us living in cities than in the countryside. By 2050 it is estimated that 75% of us will be urban dwellers.

This is uncharted territory for mankind, and it comes with a unique set of challenges. How do you curb the urban sprawl that has afflicted some of the world's megacities? How do you create cheap, affordable housing for the millions of people migrating from rural areas and reduce the population of slums? And how can power consumption be reduced in cities, which currently consume over two-thirds of the world's energy?

The new super-skyscrapers

Innovations in both technology and engineering are allowing a new generation of skyscrapers to take form. In London, the Shard is transforming the city's skyline, dwarfing the Tate Modern and St. Paul's Cathedral. The Shanghai Tower – due for completion in 2014 – is set to become China's tallest building, and in Dubai the Burj Khalifa (left) completed in 2009 is taller than any other building in the world.

Such landmark projects have been lauded and criticized in equal measure. While some celebrate them, others question their ambition. Yet many others argue that this leap in scale is necessary to prevent urban sprawl and help cut emissions.

Left Burj Khalifa, Dubai: At 828 meters, this is the world's tallest building. It is an engineering masterpiece, designed to withstand both immense pressure and extreme climatic conditions. BASF's Glenium® SKY concrete admixture was key to meeting these demands, making it possible to pump the concrete, without interruption, to a height of up to 600 meters. The admixture prevents the concrete components from separating despite the high pressure used during pumping. The early strength acquired with each story allowed building to progress rapidly, completing two stories per week instead of the one story per week which is standard in Dubai.

Those in favor of super-skyscrapers maintain that planners need to build up, not out and that this 'densification' is a mark of cities of the future. And while dense urban areas concentrate local services and reduce travel distances, they can evoke images of a grey, concrete jungle – and perhaps a lowering in living standards. But with new innovations and technology, the cities of tomorrow promise something hugely desirable: high-density living that is cleaner, more energy efficient, and more comfortable for residents.

Previously, skyscrapers were generally designed as commercial space – but today's super-tall skyscrapers are different. The Shard is not simply another office block but is described by its architect Renzo Piano as a 'vertical village' that will house homes, restaurants, offices and a hotel. The Burj Khalifa in Dubai has been pitched as a 'lifestyle community' with parks, residential apartments, shops, restaurants and hotels. Even the Shanghai Tower, at the center of Shanghai's financial district, accommodates open public spaces with restaurants, cafés, shops and gardens.

These are spaces to work, sleep, play and socialize. The old habit of walking out of the office and down the street to grab a coffee and bite to eat will be replaced by walking into the elevator and zooming either up or down to your nearest café.

Sustainable cities from scratch

While new skyscrapers are currently sprouting in existing cities, there is another trend of building entire cities from scratch – most notably in emerging economies that are seeing the greatest proportion of rural to urban migration. Songdo in South Korea, for example, is located on six square kilometers of reclaimed land, and is the world's first fully IT-networked city, where everything from grocery orders to medical check-ups can be done remotely, computer to computer. The entire city is being built on eco-friendly design principles that include vegetated green roofs to prevent stormwater runoff and promote biodiversity, energy-efficient LED traffic lights, even an underground waste system that will eliminate the need for garbage trucks.

In China, Tianjin is being billed as a new Eco-City, complete with sun-powered solarscapes, wind power, rainwater collection and many other green technologies. Amanora Hills in Pune, India, is a vast development that will include affordable housing with 20% of the space given over to parks, gardens and playgrounds. It too has respectable eco-sensitive design credentials with efficient waste management, rainwater harvesting and a solar tree plantation.

Creating gardens and parkland within these new cities is not just for aesthetic purposes, but to prevent what are called urban heat islands. These are heat-trapping urban landscapes, such as buildings and paved surfaces, that can dangerously raise temperatures – and lower air quality.

Top right One World Trade Center, New York: Due to be completed in 2013, this 541 meter building will be one of the tallest in the United States. The structure uses BASF's Green Sense® Concrete technology – a system specially developed for the North American market that combines recycled materials with admixtures to create a concrete with increased strength, lower crack potential, and improved durability. At the One World Trade Center, Green Sense Concrete has delivered environmental savings of more than 113,500 liters of fresh water, eight million kilowatt-hours of energy, nearly 340,000 kilograms of fossil fuel and prevented the generation of well over 5 million kilograms of CO₂ emissions.

Right Marina Bay Sands, Singapore: The three towers of Marina Bay Sands house a museum, two theaters, a shopping mall, 2,500 hotel rooms and suites – and the world's largest rooftop swimming pool, holding 1.4 million liters of water. As an integral partner, BASF's polyurethane foam was used to make insulated pipes for the chilled water supply network. 100% of the concrete used for this project contains BASF's admixtures. They ensure structural strength and durability. BASF also provided a waterproofing solution to seal wet areas such as bathrooms and balconies.





Breaking the mold

Designed using sustainable materials, with a contribution from BASF, the Lofthome is affordable, beautiful – and as Lofthome architect Robert van Kats explains, it is proving very popular.

Below The Lofthome's versatile design gives clients the freedom to create their own layout.

Right The steel and glass construction is a refreshing departure from the brickwork of more traditional homes in the Netherlands.



If sustainable construction demands a new way of thinking and working, the creators of Lofthome share BASF's pioneering spirit. A Lofthome is a residential home that is both affordable and energy efficient. Available in the Netherlands and, most recently, Belgium, each Lofthome is built to order, with scope for the client to choose their own layout. The team behind Lofthome has broken the mold – both in terms of its design and its conception. "In the Netherlands, the traditional process is that the architect comes up with the design, you find a contractor, and the house gets built," explains Robert van Kats, Architect Director of Blok Kats van Veen architects, and co-creator of Lofthome. "But Lofthome is the result of a collaboration of the architects, a city marketer and the contractor."

current legislation will allow. "The biggest challenge is actually the regulations," explains van Kats. "Most of the time we want to go further in sustainability than we are allowed to build." He cites one example of a town in the Netherlands where residents of self-sufficient homes are still required to pay energy companies for an energy supply they do not need.

It is an astonishing thought – that in some cases, regulation is actually limiting innovation in sustainable construction, but van Kats thinks it will change soon. In the meantime, Lofthome is proving to have mass-market appeal – something its creators never expected. "When we launched it two years ago, we thought it was a niche market," says van Kats, "but it's much wider than we thought."

Looking at the Lofthome design today, it's easy to see its appeal. Not only is it sustainable with an affordable price tag, it also looks great. "In the Netherlands there's so much lookalike housing with traditional brick work," says van Kats. Our clients often say "finally there is something else." The Lofthome's steel construction and industrial design set it apart – and because clients can choose their own layout, each Lofthome has the potential to be unique.

A collaborative approach

This collaborative approach has allowed Lofthome's creators to make the entire construction process more efficient. The structure of the home is engineered off-site, reducing the actual construction phase to just two months. "That in itself is a form of sustainability as the process is so short," says van Kats. The Lofthome team also worked together to identify the most sustainable materials. Among these was BASF's Elastopir®, a polyurethane foam used in the sandwich panels that make up the facade of each Lofthome. BASF developed this durable, fire-resistant foam to offer the highest level of insulation possible – a major factor in developing low-energy buildings. In the case of Lofthome, the insulation level is almost double that required by current Dutch building regulations. The design also includes heat recovery ventilation units, solar water heaters, triple glass walls, and other sustainable features – and every material used can be recycled.

The legislation challenge

In other words, the Lofthome's sustainability credentials are impeccable – so impeccable in fact, that in some instances they actually go beyond what

A marriage of sustainability and design

This marriage of sustainability with design aesthetic is important for van Kats and his team: "For us, sustainability is an integral aspect of design. There's no compromising."

It is an approach that many argue needs to be more widely adopted, and van Kats agrees: "I believe our professional field can contribute to a sustainable future in terms of constructing cities – but we need a lot of steps. If you arrange a good team of people [that includes] organizations and government, which really sets out a vision and a goal to have a low-energy-use city, you've already achieved a lot. Then you can start working on the future." ■

“For us, sustainability is an integral aspect of design. There's no compromising.”

Robert van Kats, Architect Director of Blok Kats van Veen architects

An alternative to urban slums

The new generation of skyscrapers and cities dazzle with their sheer ambition – but there is another less glamorous aspect to urban living. In many parts of the world, the majority of people moving from rural areas to cities will begin their urban life in a city slum – often without electricity or clean water. Since slum dwellings tend to be substandard, residents are particularly vulnerable to the forces of nature, such as flooding and earthquakes.

Creating affordable, quality homes for these people is as much a priority for city planners as conceiving new city landmarks – and innovations are allowing such homes to be built quickly and cheaply. In these situations, speed matters: The faster a structure is built, the less it costs. Safety is also important: The more robust and resilient a structure, the longer it will last.

Achieving this threefold goal of speed, safety and affordability may sound overambitious, but new technologies and innovative thinking mean this is happening already. Around the world, architects, city planners, local government and companies are working together, applying sustainable design principles to everything from the loftiest skyscrapers to the humblest homes. Such aspirations are driven less by ideals and more by sheer demand – but if humanity is to move successfully into its urban future, sustainable construction must be the shape of things to come. ■

Top & top right BASF Environmental Classroom and Wildlife Habitat, City of Rensselaer, New York: Located alongside a former brownfield site now transformed into a diverse wildlife habitat, this classroom has been created to help local schools educate young people about the living environment, and help the construction industry learn more about sustainability. Designed to achieve the U.S. Green Building Council Leadership in Energy and Environmental Design Platinum rating, the building integrates innovative construction solutions, including BASF's Exterior Insulating and Finishing System in which Neopor® boards were used to improve thermal performance by up to 20%. In addition, concrete admixtures and polyurethane foam from BASF contributed to increase construction durability and interior insulation. It is a project that brings together benefits for environment, economy and society in a way that also contributes to the local community.

Above Villa del Rey housing development, Mexico City: The rapidly growing urban population is driving an urgent need for cost-effective, affordable housing. Many new developments are substandard and without electricity or running water, but Villa del Rey is different. There, 10,000 new houses are being built from concrete, each with electricity and running water. Use of BASF's admixtures Glenium®, PolyHeed® and Pozzolith® is allowing for greater speed of construction, with the basic shell of each house completed in just seven days. With construction so quick and inexpensive, it is now possible for even low-income families to get a state mortgage and own a home of their own.



To find out more, visit: www.basf.com/future/housing

“Sustainable construction relies on collaboration. Much of our work is based around knowledge exchange. So we work to understand our customers' needs and design our innovations around these; but we also share our systems, technologies and best practice.”

Dr. Tilman Krauch, President of BASF's Construction Chemicals division and Head of BASF's Global Construction Steering Committee

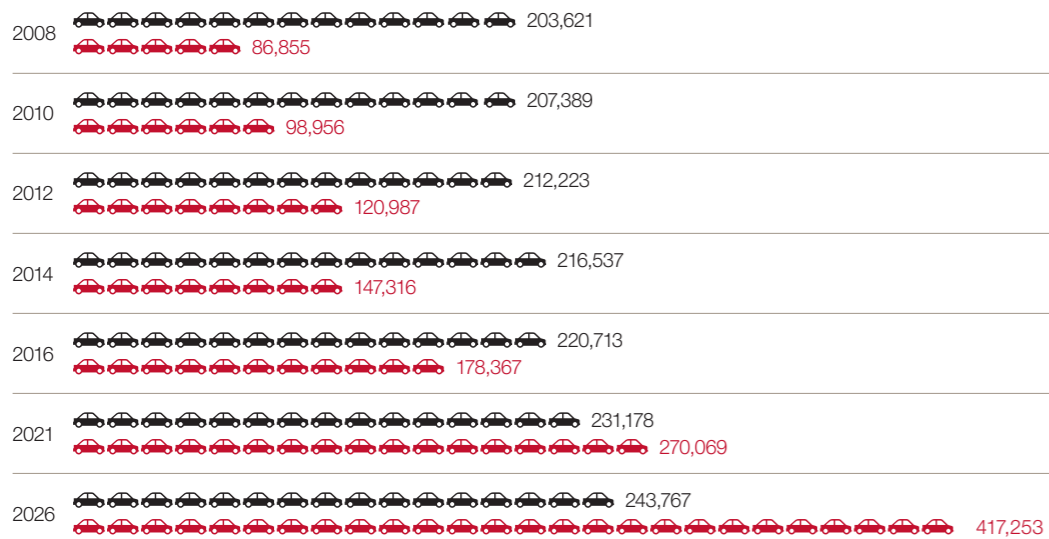


What's driving the future?

Gottlieb Daimler and Carl Benz developed the first automobile with a combustion engine 126 years ago. Since then, the car has not only changed the way we travel, it has also changed the way we work, connect with others, and even how we define ourselves. But today, mobility is facing new challenges: global population growth, rising standards of living in emerging markets, increasing urbanization, climate change and the limited availability of fossil fuels. In the race to develop the car of the future, different propulsion systems are competing for pole position.

The number of cars on our streets is growing constantly: By 2021, there will be around 1.2 billion cars on the road worldwide, an increase of nearly 300 million compared to today. Automobile manufacturers, suppliers and drivers are trying to figure out how to reduce overall fuel consumption and emissions despite the sharp growth in vehicle use. To find the answers, various types of propulsion technology – from hybrids to fuel cells and electric motors – are being improved or invented. What will we fill our vehicle's tank with in the future? Will it even have a tank?

Number of personally owned cars (in thousands)



Source: LMC Automotive

Western Europe Asia Pacific

A girl rides in a mini car ahead of the International Children's Day, in Wuhan, Hubei province, China. Currently there are only six car owners per 100 people in China, but ownership is set to rise dramatically due to the fast pace of economic growth.



The rise of the car

35 million

In 2010, 35 million new cars and trucks were sold worldwide.
Source: www.wardsauto.com

95,500

Every day, 95,500 new vehicles are added to the world's roads.
Source: www.wardsauto.com

1.2 billion

By 2021, there will be approximately 1.2 billion cars on the world's roads.
Source: LMCAutomotive

Combustion engines still rule the road

The majority of cars on the road today still contain a conventional **combustion engine**. There are a number of reasons why these cars remain so popular: They have the most mature technology, a wide range, high standards of comfort and safety as well as unique designs – at a relatively affordable price.

Furthermore, there is still potential to increase their efficiency and reduce fuel consumption. Key ways to achieve this include improved engine technology as well as lightweight construction, such as by replacing metal parts with plastic. Modern cars already contain about 15% plastic; in a few years this could rise to up to 25%. Nevertheless, experts believe the market share of vehicles with gasoline and diesel-powered engines will decline in the long term due to their comparatively high CO₂ emissions and their dependence on oil.

One possible way of preserving the environment and crude oil supplies is to switch to natural gas as a fuel. A car's engine can be powered by either compressed natural gas (CNG) or liquefied petroleum gas (LPG). Both alternatives are relatively inexpensive and meet stringent emissions requirements. Networks of natural gas fuelling stations have now been established in many countries – but this form of mobility is still based on a fossil fuel.

Alternative motor types gain ground

As well as improving conventional combustion engines, companies have also been working for several years on the switch from fossil fuels to alternative sources of energy. Among the new types of propulsion systems, **hybrid vehicles** have come the furthest towards mass market acceptance. A hybrid vehicle combines an internal combustion engine with an electric motor, in order to reduce fuel consumption and emissions. Hybrids could be brought to market faster and at a

lower price than purely battery-powered cars because they are based on a proven technology. Toyota, for example, has already sold around 3 million of its Prius brand hybrids over the past nine years.

In city traffic in particular, hybrids have advantages over conventional motors: On short trips at low speeds with frequent braking, combustion and electric engines can be efficiently combined. This is because the energy created by braking can be captured by the hybrid technology and stored in the battery. But on longer trips at higher speeds, usually only the gas or diesel engine is running and in that case the higher weight of the hybrid engine causes the car to consume more fuel.

And now the second generation of hybrids has hit the road, the **plug-in hybrid electric vehicles (PHEVs)**. These cars have a more powerful battery and can be recharged with an electrical plug. PHEV's also have a combustion engine, which can help both charge the electrical battery and act as a range extender, but its use is greatly minimised by the enhanced capability of the battery.

On-board power plant

Some manufacturers have gone a different path with cars powered by a **fuel cell**. The fuel cell creates electrical energy on board the car through a reaction between hydrogen and oxygen. This process only releases steam, no emissions. Cars equipped with fuel cells have a driving range comparable to today's vehicles with gasoline engines. Fuel cell vehicles would therefore also be suitable for longer trips – but the infrastructure for refueling does not exist yet and it remains to be seen whether hydrogen can really be produced in a cost-competitive and carbon-friendly manner. Another challenge is figuring out how to carry enough hydrogen on board.

The lithium-ion battery

Battery-powered electric cars simply weren't practical before the **lithium-ion battery** came along. It holds about three times the charge of a traditional battery and does not lose capacity with each recharge.

So how does it work?

When the battery is in use, **lithium ions** move through the electrolytes from the **negative electrode (anode)** to the **positive electrode (cathode)**. When the battery is being recharged, the ions move back to the negative electrode again. **Electrolytes** are essential for the transport of electronic charge inside the battery. These complex formulations are therefore prerequisites for improving the battery performance.

However, although lighter and more powerful than traditional batteries, lithium-ion batteries have a limited lifetime of about two years, they recharge relatively slowly, and they need special built-in circuits to prevent overheating.

Next-generation batteries

Experts at BASF are working on the next generations of batteries. The combination of lithium with sulfur or air could give batteries a higher energy density, meaning a car could potentially travel 300 kilometers to 400 kilometers on a single charge.

Right The new generation of plug-in hybrids like the Vauxhall Ampera have an increased range, despite a reduced charging time. They have the performance and style of a conventional car but emissions that are, on average, 40 grams of CO₂ lower per kilometer.



More than 80% of car trips in Europe are less than 20 kilometers.

Reducing emissions with electric cars

Electric vehicles, which are powered solely by electricity stored in a battery, are also believed to have great potential. Particularly in urban metropolitan areas with heavy traffic and resulting high emissions, electric vehicles can help make mobility more environmentally friendly. They also improve the livability of cities as these vehicles do not produce any emissions locally when they are driven. Furthermore, today's electric car with its range of around 150 kilometers per charge is mainly suited to the short distances that city drivers travel. According to a study conducted by the European Environment Agency in 2010, these vehicles would be sufficient for most car trips these days: More than 80% of car trips in Europe are less than 20 kilometers. As long as the range meets the needs of the motorist, electric vehicles are already a viable alternative. An increasing number of people today are interested in electric cars because they are stylish and modern – and they want to be one of the first to own one.

But for these cars to gain greater acceptance, advances in battery technology will be necessary: Not only are batteries a major factor in the cost of the cars – which are still relatively expensive – but they also determine how far the vehicles can travel.

Electric vehicles today mostly use **lithium-ion batteries**. Companies are researching ways to lower the cost of these batteries and improve their range to more than 250 kilometers. The next generations of batteries will be even more powerful: By combining lithium with sulfur or air, batteries could potentially power a car for 300 kilometers to 400 kilometers on a single charge.

In addition to developing battery technology, lightweight construction and temperature management are key ways of increasing the efficiency of electric cars. Less weight means less energy consumption – and that increases the vehicle's range. High-tech materials are making an important contribution to lowering weight. Efficient energy management ensures that as little energy as possible is used for cooling or heating the vehicle (see graphic on page 55).

Energy storage for smart grids

The success of electric vehicles will be dependent on more than just the technology in the cars. For electric cars to be truly environmentally friendly, the energy they use has to be generated in a carbon-neutral way. Studies show that electric vehicles have a smaller carbon footprint than other vehicles – especially when they are powered by electricity from renewable sources such as solar or wind energy. The energy mix – and increased generation of renewable energy – will be decisive.

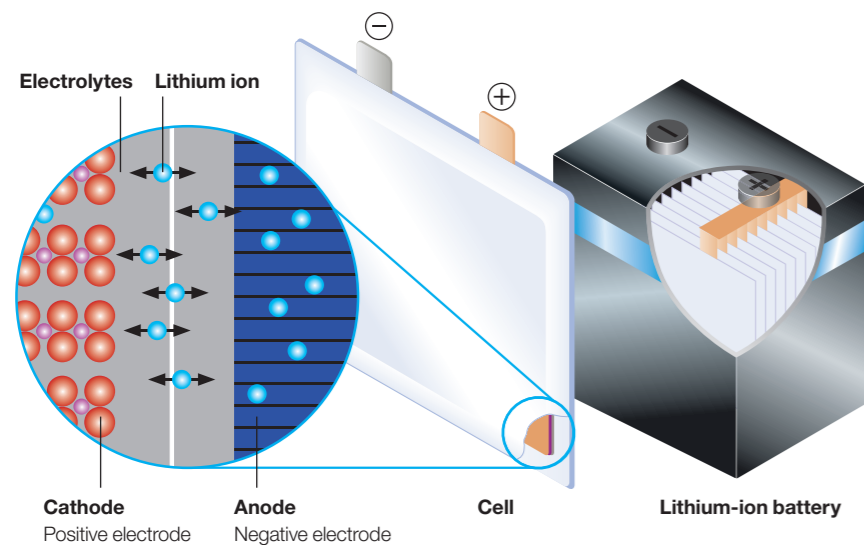
Electric cars can also be part of the "smart grid," a computerized electricity network. This is particularly practical for owners of large fleets of cars or parking garages – as well as for private individuals who don't need to use their vehicle all the time. Their electric cars can be used to store energy when not in use. The batteries of the parked cars can provide energy when solar or wind power is not sufficient to meet energy demand in peak periods. When the sun shines or the wind blows again, the batteries get recharged. The car owners gain from selling their storage capacity to the power network operators.

The future of networked mobility

Using cars as a way to store energy will be especially interesting when we start to think differently about how we get around. In the major urban centers of some industrialized countries, the car is losing its cachet as a status symbol, particularly among younger people. Instead, they are more concerned about the practical aspects of car use. Some urbanites have decided not to invest in their own car and choose instead to connect with "mobility networks" – depending on their destination, they combine driving with other forms of transportation, and instead of using their own car they share a vehicle with others. The "car sharing" model is becoming increasingly popular, especially in metropolitan areas.

Thanks to these developments, the vision of sustainable mobility is becoming more tangible day by day: The car of the future will be much lighter than previous models, will require very little energy and will have less of an impact on the environment. Different mobility concepts will be available so that we can choose the technology that best suits us and our lifestyle, for example, based on whether we live in the city or the country. ■

Modern cars already contain about 15% plastic; in a few years this could rise to up to 25%.



Source: VCI, Factbook 02



To find out more, visit:
www.basf.com/future/mobility

What makes a good relationship? It's all in the chemistry.



Above Thomas Fritzsche, BASF, Vice President Automotive OEM Coatings Solutions.



Above Martin Hülder, Head of Sales and Marketing at smart.

What happens when the pioneer in matters of urban mobility and the largest automotive supplier in the chemical industry work together on the future of electric mobility? They come up with exciting ideas and innovations. Martin Hülder, Head of Sales and Marketing at smart, and Thomas Fritzsche, Vice President Automotive OEM Coatings Solutions at BASF, talk to us about the evolution of the 'smart forvision' concept vehicle, which had its world premiere in September 2011 at the International Motor Show (IAA) in Frankfurt, Germany.

When did you start working together and why?

Thomas Fritzsche: BASF has been a supplier to Daimler (smart's parent company) for many years – they use our catalysts, coolants, plastics, paints and many other products in their cars. At the end of 2009, Daimler came to talk to us specifically about potential chemical innovations for electric cars. We quickly realized that a bigger opportunity lay in developing new ideas together.

“**BASF opened up its entire technological portfolio to us.**

Martin Hülder, smart

”

Martin Hülder: Here at smart, we are a step ahead of the competition when it comes to electric mobility: The third generation of electric smart cars will come out this year, and 2,000 vehicles from the second generation are already on the road. But, of course, we want to stay ahead, so we work together with strong and respected partners like BASF. We started collaborating because we wanted to figure out: How can we make one plus one equal three?

And how did you solve this equation?

MH: First, BASF opened up its entire technological portfolio to us. At smart, we then looked for technologies that we could use in the forvision, and how we could apply and pool them. The result is the technology implemented in the smart forvision. It is not only functional, but can also be seen, touched, and emotionally experienced. **TF:** And this is exactly what makes this car so interesting. In the smart forvision, unique design meets visionary technology. With five automotive world premieres in the car, we were able to show that uncompromising electric mobility is possible when you use materials and technologies which reduce energy consumption while also increasing the range and level of comfort.

At every major auto show, we see lots of electric concept cars. What makes the smart forvision stand out?

TF: We focused on improvements and forward-looking technologies above and beyond the drive system, as they have a huge impact on how much power the car uses. Improve them, and you improve the range. For this, we selected three key areas: lightweight construction, temperature management and energy efficiency.

MH: Development is still in its infancy here. The smart forvision's technology and design show other ways in which a car's range can be extended: It is possible to increase the range by up to 20%.

What was the biggest challenge in the project?

TF: Our ambition. We made the conscious choice to include a mix of visionary materials, some still in the lab. Therefore, both companies had to strike completely new paths – be it innovative chemistry or engineering and design solutions.

If you had to pick your favorite innovation in the smart forvision – what would it be?

TF: That is a tough question, as the car really shows that the whole is more than the sum of its parts. But I think that the first all-plastic wheel rim suitable for high-volume production is an impressive example of high-tech innovation, and of the perfect fit between both partners. The rim is made from the new high performance plastic Ultramid® Structure, developed by BASF. This material, which is just as stable as metal, reduces weight by up to 30%. As a result, the smart forvision weighs 12 kilograms less ... **MH:** ... and it looks fantastic. I personally find the application of organic photovoltaics in the smart forvision equally interesting. The solar cells are transparent, so they can fulfill three functions at once in the car: They form the roof, they allow daylight to enter, and they produce electricity at the same time. This is a typical smart solution to me – both versatile and beautifully designed. But it will be a while until this technology is available for production on a large scale.

So what's been the reaction to the car in general?

MH: Since electric mobility is an important topic all over the world right now, the car has elicited a lot of enthusiastic responses. Many people globally are currently working on developments to optimize electric cars, and we presented exceptionally functional and aesthetically-pleasing solutions that both engineers and customers appreciated very much. **TF:** I think a lot of people are still surprised to see what BASF has to offer when it comes to solutions for future mobility. To us, of course, this is not new. But the sheer amount of positive feedback we have received proves that the smart forvision project has been an important step in making our contribution tangible to the end customer.

What kind of collaboration can you imagine between BASF and Daimler to further advance electric mobility in the future?

MH: Even though the whole concept car won't be manufactured as it is, individual parts could be. We will continue to rely on our trusted relationship with BASF, and to benefit from each other's experience and knowledge in many areas. **TF:** That's right. In addition to further leveraging the technologies used in the smart forvision, we are working together on battery components such as new cathode materials, which are key to the performance and safety of batteries. This is our sustainable and holistic approach to the electric mobility of the future. ■

The smarter way ahead

On September 13, 2011, the 'smart forvision' concept car was unveiled at the International Motor Show (IAA) in Frankfurt, the largest event of its kind. Showcasing an array of cutting-edge technology, the Daimler stand generated much excitement, with the smart forvision specifically being regarded as one of the highlights. As the product of a close working relationship between Daimler and BASF, the smart forvision introduces a range of unique technical innovations in the areas of lightweight construction, temperature management and energy efficiency.



To find out more, visit:
www.smartforvision.basf.com
www.smart.com/forvision

Temperature management Infrared-reflective film
A new infrared-reflective film is applied in the windshield and side windows, protecting the car interior from heating up. The metal-free film ensures that the infrared rays are effectively reflected, but allows radio waves needed for devices such as mobile phones to pass through.

Lightweight construction High-performance composite frame
The passenger cell and other components such as the doors are made of carbon-fiber-reinforced epoxy resin – a high-performance composite material. Such materials enable weight savings of more than 50% compared to steel.

Temperature management High-performance foams
High-performance foams from BASF are fitted in the body panels. They help create a pleasant climate inside the car. The foams are highly efficient, even in thin layers, so they can be fitted everywhere in the vehicle.

Energy efficiency Solar roof: organic photovoltaic cells and OLEDs
Even in poor light conditions, the hexagonal transparent organic photovoltaic cells (OPV) generate enough energy to power the multimedia components and the fans that assist with climate management. Transparent OLEDs (organic light-emitting diodes) illuminate the interior when the door is opened or a button is pressed, consuming less than half the energy of a conventional energy-saving lamp. When switched off, they allow for a clear view outside.

Temperature management Infrared-reflective coatings
The infrared-reflective and scratch-resistant coating system supports the temperature management system. It also underlines the brilliant, high-quality design of the smart forvision: The white special-effect coating with glass flakes creates a gleaming metallic look. The color white reflects heat rays particularly well. But even surfaces coated with dark colors stay much cooler thanks to special color pigments from BASF.

Lightweight construction All-plastic wheel rim
The world's first all-plastic wheel rim, developed by BASF from a new high-performance material, saves three kilograms of weight per wheel. The new plastic has improved properties: excellent thermal and chemical stability, dynamic strength, toughness and good continuous operating characteristics.

Temperature management E-textiles
E-textiles are thin fabrics with custom-tailored conductive coatings. They replace conventional seat heating. With direct heating close to the body in the seatbacks, they provide a pleasant feeling of warmth. The e-textile technology saves energy, space and weight, and can also be found in the armrests of the doors.

Lightweight construction Multifunctional comfort seat
The seats offer a unique combination of temperature management and lightweight design. A new self-supporting plastic seat shell forms the basis of the seat. The seat foam provides for both comfort and weight savings. The fleece fabric contains superabsorbents which further enhance comfort by absorbing humidity. The seats and armrests are surfaced with breathable Steron®, making them a design highlight.

The year ahead 2012

January

- 16-19** World Future Energy Summit – Abu Dhabi, United Arab Emirates
- 25-29** World Economic Forum Annual Meeting – Davos, Switzerland
- 31** 433 Eros, the second-largest 'Near-Earth Object' on record will pass our planet. This peanut-shaped asteroid will pass within 17 million miles of Earth – relatively close by cosmic standards, but not enough to be a direct hit, as some have (erroneously) predicted.



February

- 14-16** Renewable Energy Conference & Expo North America – Long Beach, California
- 26** The Academy Awards – Los Angeles, California. Pundits predict Matt Damon will be nominated for his performance in Cameron Crowe's *We Bought A Zoo*, released in December 2011.
- 29** Leap year. Occurring once every four years, a leap year has one extra day, inserted at the end of February, making the year 366 days long.



March

- 8-18** 82nd International Motor Show – Geneva, Switzerland
- 12-13** Annual International Conference on Advances in Biotechnology (BioTech 2012) – Bangkok, Thailand
- 12-17** World Water Forum – Marseille, France
- 14-16** Globe 2012 – Conference & Trade Fair on Business and the Environment – Vancouver, Canada

The United Nations General Assembly has designated 2012 as the “International Year of Sustainable Energy for All.”



April

- 3-5** Third International Trade Fair for Electrical Mobility (eCarTec) – Paris, France
- 25** World Malaria Day
- 27** BASF Annual General Meeting – Mannheim, Germany
- 27** (until 2 May) Auto China 2012: Beijing International Automotive Exhibition – Beijing, China



May

- May** The Shard to be completed for the start of the Olympics – London, United Kingdom
- 12** (until August 12) World Expo – Yeosu, South Korea

June

- 3-7** World Hydrogen Energy Conference – Toronto, Canada
- 7** G20 Summit – Los Cabos, Mexico
- 12-14** Global Petroleum Show & Conference – Calgary, Canada
- 20-22** U.N. Conference on Sustainable Development – Rio de Janeiro, Brazil



July

- 1-4** World Cities Summit – Marina Bay Sands, Singapore
- 27** (until August 12) Summer Olympic Games – London, United Kingdom



August

- 26-31** World Water Week – Stockholm, Sweden
- 29** (until September 9) Summer Paralympic Games – London, United Kingdom

September

- 10-15** International Manufacturing Technology Show – Chicago, Illinois

October

- 8-11** International Summit of Cooperatives – Quebec City, Canada



November

- 13** Total solar eclipse – Northern Australia and the Southern Pacific

December

- 10** Nobel Prize for Physics, Chemistry, Physiology or Medicine, Literature and Peace. An additional prize for Economics is technically awarded by the Sveriges Riksbank in honor of Alfred Nobel, but is often considered as one of Nobel Prizes and awarded on the same day.
- 31** First commitment period of the Kyoto Protocol ends. By the end of 2012, the industrialized “Annex 1” countries that signed the Kyoto treaty are legally required to have reduced their emissions by an average of 5.2% from 1990 levels.

What I wish I had known when I was younger

Described by Sir Simon Rattle as ‘the most astonishingly gifted conductor he has met’, Gustavo Dudamel has captivated audiences worldwide with his artistry and passion for music. Having recently turned 30, he tells *Creating Chemistry* what he thinks are the most important lessons life has taught him so far.

“I think there is little I would change of my teenage years, or innocence I would spoil – these were such amazing times and everything was for me... well, amazing! When I was a teenager, in the Sistema, in Barquisimeto, we were surrounded by music and by people who, like me, also deeply loved the music and the process of music making, and the importance of having such beauty in our life. It meant everything.

When we are young, we never can really estimate how much our future relationships can mean to our happiness... I would never have understood then what I now have in my wife and baby, Martin. We never can quite guess the miracle of birth and the exuberance we discover at creation, at life, the genesis of where we also began. It has transformed me in a way I cannot even begin to describe.

“ We do so little to teach the young people about sensibility, about passion, about recognizing and appreciating beauty.

” The music is also something which, at the time, I never would have guessed would become so existential – we just do it – and don’t think about it. Music is as natural as anything else I do, but I cannot imagine living without it, either now or then as a teenager. I suppose as a teenager, I would never have also guessed how important sharing my passion and love for this music would also become – the responsibility which our society faces is immense. We spend most of our resources educating our young people today to be ‘effective’ and to ‘achieve’, to ‘earn’ and to ‘spend’ and to ‘accumulate’, but we do so little to teach the young people about sensibility, about passion, about recognizing and appreciating beauty. This is what I grew up with, learning how to appreciate what is right, just, pure and beautiful – and that is music.

Of course, it is not only music, but literature, dance, food, wine, visual arts... My list grows the more I discover, but I can now only fully appreciate this fact – not learning music to ‘achieve’, but learning music so that I can begin to comprehend the depth of meaning in the experience of life. That is beautiful.” ■

Gustavo Dudamel

is an internationally acclaimed Venezuelan conductor and violinist. He studied music from an early age, becoming involved with El Sistema, the famous Venezuelan musical education program. He soon began to study composition and attended the prestigious Jacinto Lara Conservatory and later, the Latin American Academy of Violin.

In 1999, along with assuming the Music Director position of the Simón Bolívar Youth Orchestra, he began conducting studies with José Antonio Abreu, the orchestra’s founder. Now in his twelfth year as Music Director of the Simón Bolívar Youth Orchestra, he is also Music Director of the Los Angeles Philharmonic and Principal Conductor of the Gothenburg Symphony.

Below Gustavo Dudamel performing his masterful interpretation of Gustav Mahler’s symphonies at a BASF benefit concert in Ludwigshafen in 2008.



Find out more

If you would like to know more about the topics covered in this edition of *Creating Chemistry*, please use the following links.



To find out more about **Water.org**, visit: www.water.org



To find out more about **the Earth Institute**, visit: www.earth.columbia.edu



To find out more about **MIT NextLab**, visit: <http://nextlab.mit.edu>



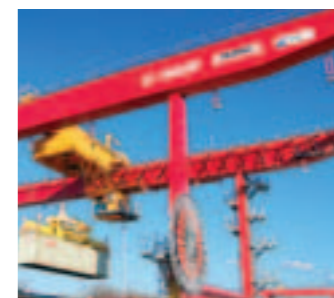
To find out more about **Blok Kats van Veen architects**, visit: www.lofthome.nl



To find out more about **mosquito nets**, visit: www.who.int/malaria



To find out more on **green living trends**, visit: www.inhabitat.com



To find out more about the **future of logistics**, visit: <http://ctl.mit.edu>



To find out more about **the smart forvision**, visit: www.smartforvision.basf.com

Imprint

Published by:
BASF SE, Corporate
Communications and
Government Relations
Elisabeth Schick

Editorial by:
BASF SE, Corporate Publications
Ink! Copywriters
Addison, London

Designed by:
Addison, London

Printed by:
Saarländische Druckerei
& Verlag GmbH

Cover photograph
Oliver Lassen

Photographic credits
BASF Archive
Andreas Pohlmann (p.3, 35)
Oliver Lassen (p.8-11, 18)
Ricardo Hantzschel (p.21-24)

Apple (p.27)
Aurum Press (p.27)
BKVV architects en
Hardeman B.V. (p.49)
Daimler (p.54, 55)
Deutscher Ethikrat (p.32)
Earth Columbia Institute (p.59)
Fox Searchlight (p.26)

General Motors (p.53)
Getty Images (p.2, 4-5, 14-15, 27,
31, 34, 37, 42-43, 44-47, 56-57)
Inition (p.26, 40)
IPA Tunes (p.27)
Irobot inc (p.27)
Mobisante Inc (p.27)
Scott Free Productions (p.26)
Shutterstock (p.28, 47)
Reuters (p.2, 4-5, 18, 47, 50-51)
Routledge Press (p.27)
UN Global Compact/
Michael Dames (p.17)
Warner Bros Productions (p.26)
Water.org (p.6-7)
YouTube (p.43)

Contact

BASF SE, Corporate
Communications
Dr. Stefanie Wettberg
Phone: +49-621-60 99223



This magazine is printed on paper that contains special chemicals made by BASF. Although you won't notice from its look and feel, the paper is 100% recycled, and combines top quality with environmental care. It is also FSC® certified.

africa's water **loves** treatment

In Africa, Guinea worm cases have been drastically reduced since 1986 by using our Abate® larvicide: an efficient water treatment product that kills insect larvae and makes contaminated sources safe again. When eradicating life-threatening diseases means helping communities to grow stronger, it's because at BASF, we create chemistry. www.basf.com/chemistry