

Food, Water and Energy Security



April 2012: The weather seems to be going crazy across the globe, with man-made climate change seen by many as an important contributing factor. Preliminary findings from the [World Meteorological Organization](#) (WMO) confirmed that 2011 was the warmest year on record. Globally-averaged temperatures in 2011 were estimated to be 0.40°C above the 1961-1990 annual average of 14°C (Source: [WMO](#)). In many parts of the world people have had to deal with unusual extreme weather events from devastating flooding to extreme drought and freezing temperatures. Such climatic shifts have a significant impact on energy, water and food security in a world where demand for all these critical elements is rising due to both population increases and rising per capita consumption. Vulnerability is increasing. As a result, energy, water and food security are top priorities for the world's leaders along with all those directly and indirectly impacted, i.e. everyone on the planet. As resource pressures increase, the challenges will be to do more with less, to eliminate waste and, ultimately, to develop self-sustaining systems that will allow us to find the balance where resources are no longer depleted but reused effectively.

To achieve the security we need, new technologies will be critical from urban farming to seaweed or algae-based biofuels. However, more important – and more difficult – will be rethinking our entire relationship with energy, water and food as this is the key to future resource security. It means potentially using less of each resource – or using it better, for example through distributed production which eliminates the waste of transmission or transportation. It also means being open to novel sources of the resources we need, for example of new, healthier foods in our diets from currently unused vegetables to artificial meat to insects.

How the future of energy, water and food security will evolve is yet to become clear, but what is already certain is that if we do not act now, the potential for resource conflicts between countries, organizations and people will rise as a recent US Intelligence report highlights (see Water below). Even in the next two decades our resource consumption patterns are likely to be radically different and diverse – and these developments might even be exciting and interesting! What is your organization doing to tackle the challenges?

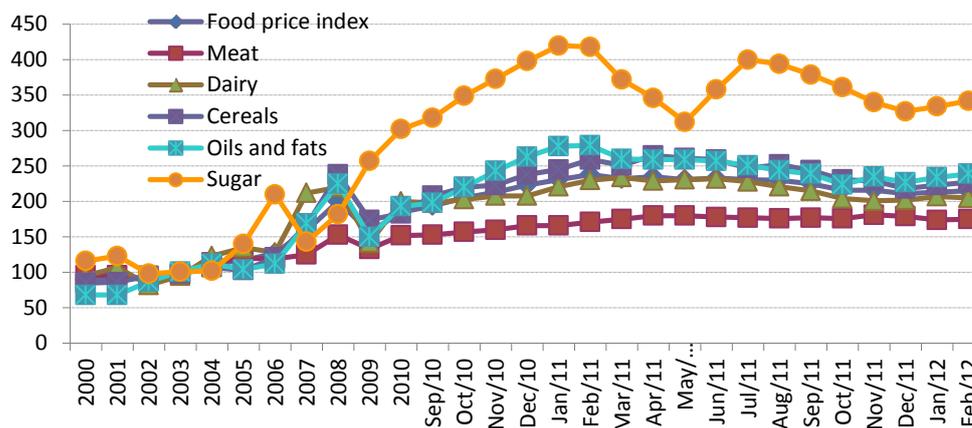
Food security

It would cost US\$3.5 billion to feed every hungry schoolchild in the world. That's around two times the takings from the movie, "Titanic," which grossed US\$1.8 billion worldwide (Source: [World Food Programme](#)). Food security is a topic that affects us all. It is an unavoidable topic, as whether

affluent, middle class or poor, we all need food for survival. The world has never before fed so many people with such high quality food; yet, still 13.1% or almost 1 in 7 people are hungry, nearly all of them in developing countries. By 2050, we will need to feed more than 9 billion people. To do so, food supplies will likely need to increase by 50-70%. As a result we are seeing new forms of collaboration and innovation in the food industry, aimed at rethinking how food is produced and how the world is being fed. While some believe scientific breakthroughs are critical to solve the food insecurity challenges, others believe that knowledge, tools and policies have a critical role to play in addressing the food crisis. The reality is likely to be somewhere in between, along with changes in consumer behaviours and consumption patterns.

As agriculture around the world feels the disruption of climate change, food commodity prices are soaring and becoming increasingly volatile while farmers worldwide are trying to adapt to a new and challenging agricultural future. But the future of food production is no longer solely in the hands traditional farmers and food producers. The future of farming and our diets will also be driven by artificial cultured food, biotechnology breakthroughs and urban settlements that grow their own food locally in old buildings and skyscrapers to avoid waste, and to save energy and water. See more [here](#). For this to happen many mountains need to be climbed but the seeds have already been sown!

Primary Food Commodity Price Indices



Source: FAO

In Action!

Drought: As of March 2012, 31,295,000 people are experiencing exceptional drought conditions (Source: [UCL](#)). A new report from the [National Center for Atmospheric Research](#) shows that the global percentage of dry areas has increased by about 1.74% of global land area per decade from 1950 - 2008, suggesting that droughts are likely to become more severe in the coming decades. Portugal, already struggling in the current economic crisis, has experienced its driest February in 80 years, destroying crops and sparking forest fires. Mexico is experiencing severe drought affecting 22 of Mexico's 32 states causing a 40% drop in agricultural production which could lead to food shortages over the next few months, (Source: [Think Progress](#)). These countries are not alone; many others are struggling with severe droughts which are impacting food production, e.g. Syria, Argentina, the US, South-East England, China, Thailand and the West African Sahal region.

Flooding: More than 5.5 million people were affected by general or flash floods worldwide in 2012 (Source: [International Disaster Database](#)). Only 3 months into 2012 the Philippines has already been hit several times by natural disasters in forms of landslide, earthquakes and heavy flooding killing at least 70 people and affecting more than 13,000 (Source: [Recent Naural Disasters](#)). In March 11, 2012 rain hit the southern tip of Chile near Punta Arenas, flooding nearly 240 acres of land in the worst storm seen in 22 years. The current damage estimates suggest that 4,000 people and 500 homes

suffered losses ([USDA](#)). Peru, Papua New Guinea, Australia and the USA have also experienced flooding this year.

Trees as fertilizer: According to newly released research from the [World Agroforestry Centre](#) a new and exciting trend is emerging on a continent that is constantly struggling with weather problems, famine and unaffordable food prices. Around 400,000 poor African farmers are now using fast growing trees and shrubs as fertilizer to provide their crops with critically needed nutrients and many of these farmers are reporting significant increases in their maize yields. The research also found that farmers planting these types of trees experience better water efficiency resulting in higher yields because the trees help to reduce run-off and soil erosion (Source: [Science Daily](#)).

Look Out For...

Seaweed – the new biofuel: It is suggested that globally 13% of grain, 15% of vegetable oil and 30% of sugarcane production will go towards biofuel production by 2020 ([Biofuels OECD-FAO Agricultural Outlook 2011-2020](#)). First generation biofuels are often seen as competing with food demands as they use edible biomass, while the second generation primarily uses non-edible biomass such as plants and wood waste. But the search is still on for sustainable feedstock that does not impact the food chain. Third generation biofuels are algae-based, while fourth generation technologies still under development include: Pyrolysis, gasification, solar-to-fuel, and genetic manipulation of organisms to secrete hydrocarbons. The latest addition to biofuel research is marine macroalgae, also known as seaweed. It looks like a promising source of bioethanol but has remained virtually unexplored until now. The advantages: It can be grown more quickly than land-based crops and harvested as fuel without sacrificing arable land (Source: [Science Daily](#)).

Artificial meat: Meat consumption is projected to double worldwide in the next 40 years; already now we are using more than 70% of all agricultural land for meat production (Source: [The Guardian](#)). The FAO suggests that 18% of emissions come from the livestock sector while another study from EU found that the livestock sector represented just 9.1% of total emissions in the EU or 12.8% including land use (Source: [Farmers Weekly](#)). To reduce the environmental impact of livestock, scientists are focusing on the potential for making in vitro or cultured meat. Dr Mark Post, head of physiology at [Maastricht University](#), now plans to unveil a complete burger – produced at a cost of more than £200,000 in October 2012 (Source: [The Guardian](#)). But is artificial meat, which has never been a part of a living animal, a way to cut back on CO2 emissions, water use and energy? According to Dr. Post in vitro meat from cells would use up 80% less energy. Meat lovers get ready for your future!

Vertical urban farming: Rooftop gardening has been popular for years. Now in the quest to meet increasing food demand vertical urban farming is on the rise. The goal: Clean, cheap food, in abundance – plus more land for other uses and reduced CO2 emissions. In Sweden the world's first Plantagon Greenhouse for Urban Farming has broken ground. Aside from offering an innovative vertical farming solution the Plantagon also plans to develop integrated solutions for energy, excess heat, waste, CO2 and water (Source: [Clean Technica](#)). A smaller example in Chicago is the transformation of a former meatpacking factory into a nascent fish and vegetable farm. All the building's energy needs will come from an onsite biodigester, producing methane to fuel a combined heat and power plant. The digester will consume all the building's food waste, as well as taking some from neighboring food manufacturers (Source: [Green Future Magaine](#)).

How businesses are responding...

- In January 2011, a coalition of business, governments and farmers launched a strategy to significantly [increase food production](#) while conserving environmental resources and spurring economic growth. Initially the approach was implemented in Tanzania and Vietnam and has now been extended to Indonesia and Mexico, and a regional partnership in sub-Saharan Africa. The approach was led by 17 global companies (Archer Daniels Midland, BASF, Bunge Limited, Cargill, The Coca-Cola Company, DuPont, General Mills, Kraft Foods, Metro AG, Monsanto Company, Nestlé, PepsiCo, SABMiller, Syngenta, Unilever, Wal-Mart Stores Inc., and Yara International), with a further 9 joining in 2011 (Agco Corporation, Bayer AG, Diageo, Heineken NV, Maersk, Swiss

Reinsurance Company Ltd., The Mosaic Company, Teck Resources Limited, Vodafone Group). The strategy sets ambitious targets for collective action to increase production by 20%, decrease greenhouse gas emissions per tonne by 20% and reduce rural poverty by 20% each decade.

- Food giant [Unilever's Sustainable Living Plan](#) is designed to deliver three key outcomes by 2020: (i) Help more than a billion people take action to improve their health and well-being; (ii) Decouple the company's growth from its environmental impact across the product lifecycle, with the goal of halving the environmental footprint of the making and use of Unilever products; (iii) Enhance the livelihoods of hundreds of thousands of people in the company's supply chain. In doing so, it will help enhance the sustainability of agriculture and food security in the future.
- [Heinz](#), another food giant, has designed a [sustainability plan](#) focusing on nine specific environmental areas to be delivered by 2015: Greenhouse gas emissions – overall 20% reduction; energy consumption – 20% reduction through improved operational efficiency; packaging – 15% reduction through use of alternative packaging materials and reduction of existing packaging; transportation – 10% reduction through improved efficiency of distribution network; renewable energy – 15% to come from renewable sources, including solar, biomass and biogas; agriculture – 15% reduction of carbon footprint, 15% reduction of water usage, improvement of yields by 5% through use of hybrid tomato seeds that require less water, fertilizer, pesticides and fuel to harvest; water – 20% reduction through reuse and improved sanitation techniques; solid waste – 20% reduction through increased recycling and reuse of waste; employees – Increase employee engagement through a voluntary personal sustainability campaign.

Water security

The world's water, one of our most critical resources, is also facing growing pressures from climate change and increasing demands from agriculture and industries that are being fuelled by a growing population and an emerging middle class. Only about 2.5% of the global water supply is potentially available for human, animal and plant consumption. About 70% of this is used by agriculture, 22% by industry and 8% by urban and rural domestic needs. Of the world's population 20% have no appreciable water supply, 65% share low-to-moderate supplies (>0–50% of global runoff) and 15% live with relative water abundance (50–100% of global runoff) (Source: [UN's World Water Development Report 4 – Knowledge Base](#)). Again, rethinking how we use water and implementing new technologies to develop new supplies, reduce waste and pollution and recycle water will be critical if we are to avoid the very real prospect of conflict over future supplies.

Water Facts
884 million people lack access to clean water – that is almost the 3 times the size of population of the United States.
The water and sanitation crisis claims more lives through disease than any war claims through guns.
3.575 million people, equal to the entire city of Los Angeles, die each year from a water related disease. Every 20 seconds, a child dies from a water-related illness.
People living in the slums often pay 5-10 times more per liter of water than wealthy people living in the same city.
An American taking a five-minute shower uses more water than a typical person in a developing country slum uses in a whole day.
Women spend 200 million hours a day collecting water.

Source: [Water.org](#)

In Action!

Water shortages: The study "Facing Shortage: Big Cities from Beijing to Delhi – And Nature, Too" from [The Nature Conservancy](#) et al. suggests that by 2050, major cities including Beijing, Mumbai, New Delhi, Mexico City, Lagos, Tehran and many more will not have enough water available nearby unless

significant new efforts are taken by the cities to address the problem. Another new study in [ACS's Journal of Environmental Science & Technology](#) suggests that more than 1 in 3 counties in the United States could face a "high" or "extreme" risk of water shortages due to climate change by the middle of the 21st century. It concludes that 7 in 10 of the more than 3,100 U.S. counties could face "some" risk of shortages of fresh water for drinking, farming and other uses. (Source: [Science Daily](#)). How will your city be impacted?

Fishing for debris: It is estimated that 46,000 pieces of plastic are afloat on every square mile of the ocean – with over 129 million square miles of ocean that is a lot of plastic! (Source: [Global Partnership for Oceans](#)). In developing countries 1 billion people depend on fish as their primary source of protein but unfortunately many seabirds, turtles, fish and other sea mammals mistake plastic for food and either die or become unsuitable for human food. Last year an industry-led pilot project “Waste Free Oceans” was launched with the aim of reducing floating marine debris on Europe’s coastlines by 2020. For a week in November Belgian fishermen were fishing for plastic and being compensated for it. Although initially the EU Member States will subsidize this project, Europe believes that ultimately this practice will be profit-making. (Source: [Waste Free Oceans](#))

Harvesting rainwater: As water shortages grow more governments are making policies and passing legislation to address the increasing demand for water. In India many state governments have made rainwater harvesting mandatory in buildings. In Nepal, the government has enacted policies and guidelines on rainwater harvesting, while cities such as Dharan are providing discounts of up to 30% on building permit fees for houses that install rainwater harvesting systems. In the United States, several states and cities provide incentives for water conservation. Residents of Arizona for instance were offered a one-time tax credit of 25% of the cost of water conservation systems such as grey water and rainwater recycling, up to a maximum of US\$1,000. (Source: [UN's World Water Development Report 4 – Knowledge Base](#)).

Look Out For...

Destabilising countries: In 2008 food riots broke out around the globe, from Egypt to Haiti to Bangladesh, as basic food prices skyrocketed. Again in 2011 violent food riots broke out again, this time in Tunisia and Algeria contributing to the social unrest which led to the Arab Spring. A report from the American intelligence community requested by the Department of State has warned that future problems with water could also have a destabilizing effect in countries in North Africa, the Middle East and South Asia over the next decade. The report suggests it is likely that some countries could use water as a political and economic weapon towards their neighbors and that major facilities like dams and desalination plants could become targets of terrorist attacks. (Source: [New York Times](#))

Seawater desalination: In the quest to solve the world’s water problems, new and more efficient methods are being tested to desalinate seawater. Reverse osmosis – forcing seawater through a membrane that filters out the salt – is the leading method for seawater desalination today. Studies from Jason Reese, Weir Professor of Thermodynamics and Fluid Mechanics at the [University of Strathclyde](#) now show that it is possible to use carbon nanotubes (CNT) in the reverse osmosis process to desalinate water. Realistically CNTs can expect to have water permeability 20 times that of today’s reverse-osmosis membranes, reducing the cost and energy required to generate desalinated water. (Source: [Science Daily](#)).

Drought tolerant crops: As agricultural land experiences increasing instances of drought, it is critical to develop crops that can resist a drier climate. Anabel Robredo, a biologist at the [University of the Basque Country \(UPV/EHU\)](#), has confirmed that the crop barley is actually geared to adjust to climate changes, possessing self-defence mechanisms to tackle a lack of water (Source: [Basque Research](#)). Another team of researchers from [University of California](#) discovered in 2009 that abscisic acid receptors were important for a plant when coping with drought. This has now led the team to successfully supercharge an *Arabidopsis* (a model plant used widely in tests) by modifying the abscisic acid receptors so that they can be turned on at will and stay on (Source: [Science Daily](#)).

Film farming: [Agricel](#), based in Dubai, has introduced a novel approach to farming using a hydromembrane composed of water-soluble polymer and hydrogel, which avoids the need for soil. The benefits of this approach include a 90% reduction in water required to grow crops – critical in water-stressed areas such as the Middle East – plus an 80% reduction in the use of fertilizer, and resistance to bacteria and viruses without the need for pesticide. The return on investment numbers look good according to the company, so expect to see this novel technique spreading. See the company website and [Springwise](#) for more.

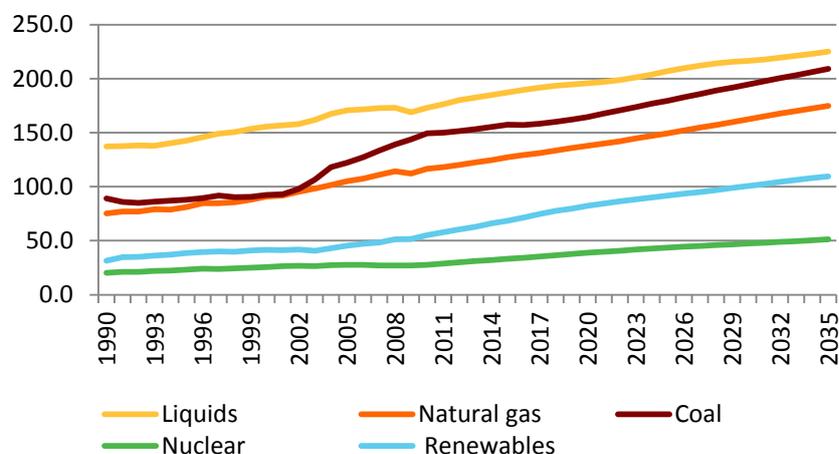
How businesses are responding...

- **Nestlé:** In 2011 food giant Nestlé won the Stockholm Industry Water Award. Through the program “Creating Shared Value” the company has reduced overall water consumption by 28% since 2001. In this period Nestlé has reduced its water withdrawals by 58% per tonne of product and water discharges by 64% per tonne of product. It has also reduced energy consumption by 42% per tonne of product during the same period, with renewable energy now representing 12% of its total energy consumption. (Source: [Nestlé](#))
- **Global Partnership for Oceans:** Is a brand new and powerful coalition of governments, NGOs, intergovernmental bodies, scientists and businesses, dedicating resources to the world's overfished, heavily polluted and increasingly warming oceans. Launched by the World Bank in February 2012, it aims to raise US\$1.5bn for the world's oceans, doubling marine protected areas and rebuilding fish stocks. (Source: [World Bank](#) and [The Guardian](#))
- **Sara Lee:** In 2005, the giant American consumer-good company used 5.02 million million cubic meters of water in its manufacturing operations. In 2010, it used 3.91 million cubic meters, a 22% reduction in consumption. This volume of water reduced is approximately four times greater than the volume of the Empire State Building. During the same period, the company reduced the volume of water discharged by 24%. On top of that the company has, around the globe since 2005, reduced total energy consumption by 14%, greenhouse gas emissions by 12% and waste-to-landfill by 20% (Source: [Sara Lee](#)).

Energy security

Energy is essential for the development of and prosperity of the world’s societies. For people living in the developed world the problem of energy is not shortage but waste, while billions simply lack access to modern electricity in other parts of the world. We are using more energy than ever and demand is rising rapidly as the world’s population increases along with incomes which make energy-using devices from cars to televisions affordable to more of the world’s emerging middle class.

World energy consumption by fuel, 1990-2035



Source: EIA's International Energy Outlook , 2011

According to the EIA's International Energy Outlook 2011, total world consumption of energy is projected to increase by a staggering 53% from 2008 to 2035 with the largest projected increase in demand in the non-OECD economies. Energy consumption is estimated to rise from 505 quadrillion Btu in 2008 to 770 quadrillion Btu in 2035. Today, about 80% of the energy used in the world is produced using non-renewable sources. This percentage is expected to remain approximately the same until 2035 unless we find some new and inexpensive energy sources, agree on a worldwide enactment of environmental legislation and/or make some significant energy technology breakthroughs.

In Action!

Raw material shortages: Suppose we run out of critical raw material essential for manufacturing low-carbon technologies? In a new report, scientists at the [Joint Research Centre \(JRC\)](#) highlight that the five metals – neodymium, dysprosium, indium, tellurium and gallium – show a high risk of shortage. A large-scale deployment of solar energy technologies, for example, will require half the current world supply of tellurium and 25% of the supply of indium. At the same time, the envisaged deployment of wind energy technology in Europe will require large amounts of neodymium and dysprosium, (about 4% of the current global supply of each) for permanent magnet generators, which could only be eased if the supply of such metals in the future is increased, which may not be simple. Virtually the whole European supply of these metals comes from China. (Source: [Science Daily](#))

The power of wind: Malta is considering a proposal by the Swedish company [Hexicon](#) to build the world's largest floating wind farm. It would consist of 36 turbines arranged around a 460-meter-wide platform, tethered to the ocean floor by cables. The proposed site for the platform is 11 nautical miles off the island's northeast shore. It would be far enough away to take advantage of high ocean winds (and be more or less out of sight) yet close enough that it could be connected to the country's electricity grid without too much trouble. (Source: [Fast Company](#)). A Stanford University study of global wind capacity estimates that harnessing 20 percent of the available wind on the planet would provide seven times more electricity than the world now uses.

In a world of clean energy: More people than ever are challenging the preeminence of oil as energy source. Already many smaller energy-using devices can be bought as solar only but what about a solar-powered catamaran? [Tûranor PlanetSolar](#), according to its builders, is the largest of its kind in the world. It is 24-feet-tall, 100-feet-long and 50-feet-wide and with 38,000 photovoltaic cells it is now close to ending its 'around the world journey' using nothing but solar powered energy. (Source: [Singularity Hub](#)).

Look Out For...

Making our world cleaner – the case of eliminating oil subsidies: Renewables have come a long way in the last decade and are very slowly taking market share from fossil fuels. Despite serious climate talks among the world's leaders to reduce CO2 emission, the fossil fuel industry has historically received six times as many subsidies as the clean-energy industry globally, and continues to do so. Worldwide fossil fuel subsidies totaled US\$409 billion in 2010, up US\$110 billion from 2009, driven higher by an increase in energy prices. Global renewable subsidies (for biofuels and renewable electricity) totaled US\$66 billion in 2010, 10% higher than in 2009, with US\$44 billion subsidizing the cost of renewable-based electricity and US\$22 billion subsidizing biofuels. Estimates suggest that eliminating fossil-fuel consumption subsidies would reduce global carbon-dioxide emissions by 1.5 to 2 billion tons by 2020 and at the same time it would probably cut global energy demand by 3.9% or the equivalent of 600 million tons of oil. The abolition of these subsidies would reduce demand by almost 5 percent by 2035 (Source: [International Energy Agency \(IEA\)](#)).

Hydrogen from a grain of salt: Bruce E. Logan, Kappe Professor of Environmental Engineering at [Penn State](#) is using microbial electrolysis cells to produce hydrogen from wastewater or organic byproducts, and all that is needed is a grain of salt or two. The key to these microbial electrolysis cells is reverse-electrodialysis or RED that extracts energy from the ionic differences between salt water and fresh water. According to the Professor "This system could produce hydrogen anyplace that there is

wastewater near sea water," and "It uses no grid electricity and is completely carbon neutral. It is an inexhaustible source of energy." (Source: [Science Daily](#))

Fracking: Hydraulic fracturing (HF) or fracking is a process used to maximize the extraction of underground resources, e.g. oil, natural gas, geothermal energy and even water (Source: [EPA](#)). Fracking has triggered a gold rush, not only among energy companies that are increasingly applying this method, but also among water-treatment companies as this method involves using significant amounts of water. According to the [American Department of Energy](#) 3.8 million gallons are needed for fracking one well of which about 1 million gallons returns to the surface as wastewater needed to be treated for different chemicals. Fracking has increasingly been suggested as a possible source of earthquakes as well as contaminated soil – as this method of retrieving “trapped” resources is on the rise, advantages versus risks still need to be examined further (Source: [Wall Street Journal](#)).

How businesses are responding...

- **Puma:** Has become the first company in the world to put a value on the eco services it uses to produce its sports shoes and clothes, signaling a radical change in the way business will account for its use of natural resources. Puma has published an economic valuation of the environmental impacts caused by greenhouse gas emissions (GHGs) and water consumption along its entire supply chain and has committed to the more difficult task of integrating both its social and economic impacts. (Source: [The Guardian](#))
- **Birmingham Airport:** Has committed itself to a sustainable future. By installing 200 solar panels on the roof of its terminal generating 40,000 kwh a year, the airport will be able to save 22 tons of carbon dioxide every year. It is the first renewable energy and zero carbon installation at Birmingham Airport but is part of a bigger project to improve its sustainability. (Source: [Cogeneration & On-Site Power Production](#))
- **Rengo:** The Japanese corrugate manufacturer has now completed a construction of a biomass incineration facility at its Tonogawa Division in Japan. The facility has been built to utilize paper sludge and other waste from the plant's paper production processes and should reduce fuel costs as well as cutting 6,000 tons of CO2 emissions every year. (Source: [Cogeneration & On-Site Power Production](#))
- **BMW:** In July 2011, a BMW dealership near Vancouver became the first business in British Columbia to install a commercial-scale wind turbine. Now in Leipzig, Germany, automaker BMW will power its factory by using a 100% wind power. The plan is to build four turbines that should be able to provide the necessary energy by 2013. BMW says that it hopes the plant can become an example of green best practice for its other factories. BMW is already, in several locations, using other types of renewable, e.g. solar panels, and landfill gas. (Source: [Environmental Leader](#)).
- **Hershey's:** Has implemented a lighting efficiency program at all plants and distribution centers. The company has reduced energy consumption from lighting by more than 50%, which represents an annual reduction of more than 20,500 metric tons of CO2 emissions. In its U.S. manufacturing plants and distribution centers it has realized energy savings of 9.55%, and annual savings of US\$3.9 million between 2007 to 2009, with a total investment of approximately US\$9.6 million. Through its Project Overdrive the company has moreover reduced fuel consumption in transport operations in 2009 by 1.3 million gallons of diesel fuel, saving US\$6.2 million. (GE: Food, Beverage & Agribusiness 2011 Special Issue and [Hershey's](#))

In May: Look out for trends in action on Transformational Innovation!