

# Sustainable Business

## Green Technology

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# Stronger political will is needed to meet goals

Governments, businesses and NGOs have to collaborate if they are to reverse the world's environmental problems, says *Sarah Murray*

As US citizens and agencies embark on rebuilding damaged infrastructure in the wake of hurricane Sandy's devastation, debates will no doubt emerge on how best to protect against future storms. But while upgrading power, transport and other systems is part of the answer, the clean up may also prompt policy makers to consider the role of green technology in building climate resilience.

The extent to which climate change is to blame for Sandy is unclear. A convergence of meteorological factors could have created such a storm, even without climate warming. But rising sea levels will increase the impact of storms, particularly in coastal areas. Many hope that as stronger evi-

dence of shifts in the world's weather patterns emerges, this will drive investment in green technologies – those that not only help prevent climate change by reducing greenhouse gas emissions but that also minimise the effects of climate warming and extreme weather events.

On the global policy front, however, consensus is weak. This year's Rio+20 summit must have come as a disappointment to those in the clean tech sector. At the summit – so named because it was held 20 years after the first 1992 Rio Earth Summit – few new national commitments were made and previous targets were watered down.

In the world's largest economy, few US politicians have been willing to broach the topic of climate change

until Sandy propelled it back on to the agenda.

Despite the lack of political will, not all is gloom when it comes to green technology. National governments are finding ways to foster the development of the sector and, in the US many local, regional and city administrations are doing the same. Meanwhile, the private sector continues

**Nimble start-up companies are driving many of the innovations in the clean tech sector**

to invest in clean technology. Much of the funding is being channelled into clean energy – products and services designed to reduce energy consumption and increase the proportion of renewable fuels in the power supply. Nimble start-up companies are driving many of the innovations. Examples range from US-based Aquion Energy, which has developed advanced battery systems based on ambient-temperature sodium-ion technology, to Nualight, an Irish producer of energy-efficient display lights for grocery stores that use LEDs (light emitting diodes).

Both are among those on the 2012 Global Cleantech 100 Companies, a list put together by the Cleantech Group that takes stock of companies

and types of companies that are likely to make the biggest commercial impact in the next five to 10 years.

In this year's report, while the number of solar companies on the list is down 40 per cent since 2009, energy efficiency has 22 companies on the list, up from 15 in 2010.

The report's authors say companies are increasingly seeking answers to immediate, specific problems rather than investing in longer-term developments with less certain goals. "This leads to a lower tolerance for technology risk and/or a lower tolerance for the big bet," writes Cleantech Group's Richard Youngman in the report.

Nevertheless, investment in clean energy continues, rising to a record

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Storm damage: New Jersey after hurricane Sandy, which some hope will revive the topic of climate change in the US Reuters

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Carbon capture is an opportunity ripe for exploitation but incentives are few

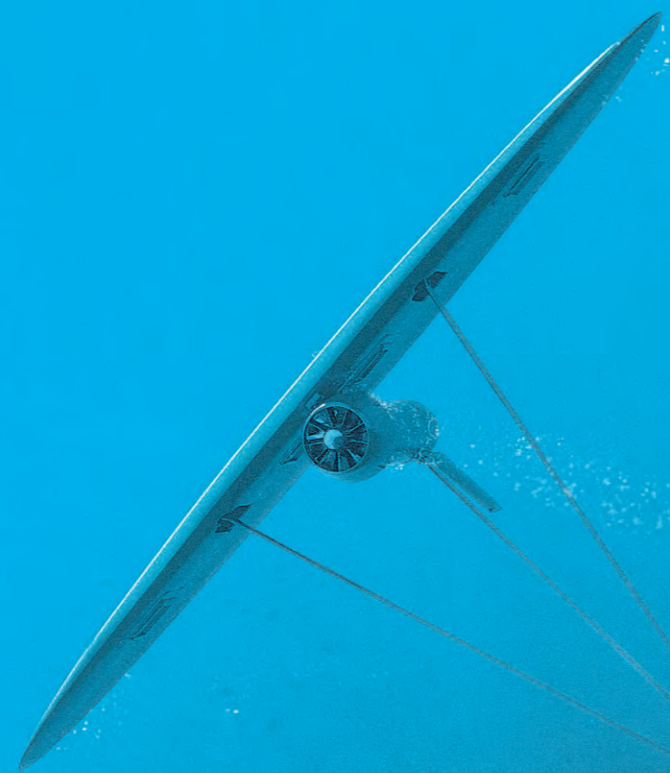
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## Sustainable Business Green Technology

# Matching up companies is a move to a world without waste

## Cement One company's refuse is another's raw material, writes Sarah Murray

With extremely high temperatures required to heat the limestone, cement is a product with a heavy carbon footprint. However, as companies start to use more industrial waste and renewable energy in cement production, some believe the sector could become a leader in "industrial symbiosis" (where one company's refuse becomes another's raw material), accelerating progress towards a zero-waste world.

Manufacturing clinker – which traditionally makes up about 90 per cent of cement – is the most energy-intensive part of the product. This is partly because changing limestone to clinker needs temperatures of up to 1,500C, which means burning large amounts of fuel. An important step in reducing cement's carbon footprint will be to increase the energy efficiency of cement plants and find alternative fuels to power furnaces.

However, a second substantial source of emissions comes from the chemical conversion process itself, during which calcium carbonate is extracted from the limestone, generating large amounts of carbon dioxide.

"From a chemical standpoint, the process generates CO<sub>2</sub> in addition to the burning of fuel," explains Howard Klee, former director of and adviser to the Cement Sustainability Initiative at the World Business Council for Sustainable Development (WBCSD).

Increased plant and fuel efficiency cannot address these emissions, which means cement makers also have to find alternatives to clinker.

This has a dual benefit. First,

cement made with less clinker reduces the fuel needed to power the kilns. Meanwhile, cement that has a lower proportion of clinker has generated fewer emissions related to the chemical decomposition of limestone.

A range of materials can be used to replace clinker. These include active minerals derived from industrial waste – such as slag from steel mills and fly ash, a byproduct of power plant coal combustion – as well as naturally active materials such as volcanic ash.

The potential for cement production to use industrial waste is substantial. For example, slag can be used both to power the kilns and as a replacement for clinker. And as well as powering their kilns with renewable energy, cement plants can turn anything from waste wood and sewage sludge to old tyres and plastics into fuel.

"Our process allows us to use waste as fuel and integrate that into the product without any risk to health," says Raul Quintal, director of operations planning and performance, at Cemex, one of the world's largest cement producers.

For those in the waste management sector, cement kilns – with their high temperatures – provide a safe way of destroying unwanted and often hazardous materials, helping solve public health and safety challenges.

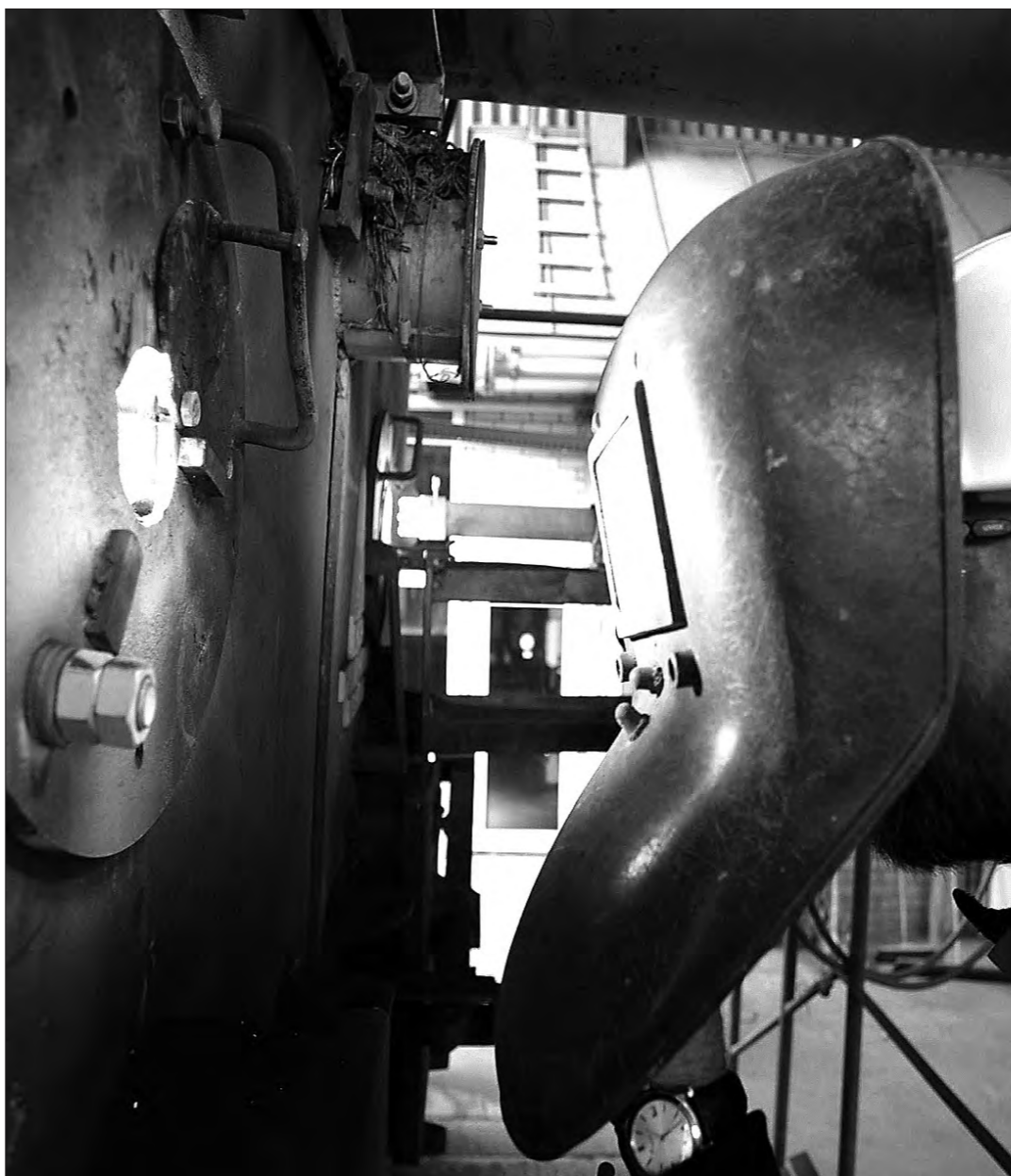
In 1999, when the Belgian government needed to dispose of thousands of tonnes of meal and fat from potentially contaminated animal products, it requisitioned cement plants, which could guarantee the complete destruction of the contaminants in the kiln, while also reducing their emissions

through the fuel substitution. Philippe Fonta, director of the WBCSD's Cement Sustainability Initiative, cites the example of discarded tyres, which in some places are left in dumps where they collect water and become breeding grounds for malaria-carrying mosquitoes. "If these used tyres are no longer abandoned but eliminated by a cement plant, you also have societal benefits," he says.

The technology behind this kind of matchmaking, or coprocessing, is relatively well established. The bigger challenge, however, lies in creating the kinds of infrastructure and industry collaborations that facilitate the trading of waste between waste producers and cement producers.

"[Coprocessing] is a pretty elegant piece of industrial ecology," says Raj Sapru, director of advisory services at Business for Social Responsibility, a US-based business association and advisory group. "But since it involves steel making and cement making, it means a market has to exist."

As new facilities are planned, the inherent efficiency in using waste



**Heavy footprint: converting limestone to clinker needs temperatures of up to 1,500C**

materials in cement could influence location selection when deciding where to build a cement plant.

"We still have to supply a market," says Mr Quintal. "But when choosing between locations, one of the factors to consider is the availability of and access to other industry clusters and take advantage of those and whatever those clusters produce."

Of course, with a legacy of existing cement plants, it will take time before the industry can become fully integrated with the waste management sector. And some materials are not suitable for processing by the cement industry, including nuclear waste, infectious medical waste, batteries and untreated mixed municipal waste.

Moreover, for the cement sector to become a key partner in the management of waste, governments need to formulate the right incentives.

"To hit fast forward, there needs to be more collaboration between business, government and civil society," says Mr Sapru. "Cement is an ancient technology – it's not about the technology. It's about the political will."

As new facilities are planned, the inherent efficiency in using waste

# Put heads together for clean thinking

## Incubators

### Sarah Murray finds sectors joining forces to drive innovation

After plugging a device called the modlet into electrical outlets, people in homes and offices can cut wasted energy by managing appliances not in use remotely via the web. ThinkEco, which developed the modlet, did so from within the walls of the NYC Acre, one of a growing number of incubators dedicated to the development of clean tech businesses.

For the start-ups in the portfolio of NYC Acre (the New York City Accelerator for a Clean and Renewable Economy) a strong focus is the development of technologies that address energy use in the urban environment. "We want to help drive innovation at scale and New York with its 1m buildings is a huge market," says Michal Kotch, operations director.

However, while clean tech incubators aim to use market forces to drive a cleaner economy, developing solutions that address issues such as carbon emissions, water consumption and waste is different from fostering information technology or biotech innovations in that it requires input from a wide range of sectors and organisations.

"People have understood the technology involved in building cleaner solutions is a lot more complicated because it relies on combinations of hardware, product design and product development," says Colm Reilly, government and public sector expert at PA Consulting.

As a result, when it comes to launching clean tech incubators, governments, academia and the private sector are increasingly forming partnerships.

"The incubation of new ideas needs to be supported by a diversity of structures," says Daniel Esty, commissioner of the department of energy and environmental protection for the state of Connecticut, which has launched a venture capital fund called Connecticut Innovations.

NYC Acre is a good example of this cross-sector approach. The incubator is run by NYU-Poly, funded primarily by the New York State Energy Research and Development Authority and designed not only to support start-ups but also to help commercialise university research.

"And we work very closely with [private sector] partners like Con Edison, National Grid, Verizon, IBM, Cisco and others," says Mr Kotch. "They serve on our advisory board, as mentors, as sounding boards, as inspiration. They're also game changers if you're a start-up and are able to get in to their supply chain."

Similarly, LA Cleantech Incubator, a Los Angeles-based non-profit organisation that receives funding from the CRA/LA, a local authority and the Los Angeles department of water and power, works with the region's research centres and universities.

Outside the US, cross-sector partnerships are emerging to establish clean tech incubators. In February, the Carbon Trust, a government-backed advisory group, and General Electric announced the setting up of a \$5m business incubator fund designed to help European companies develop low-carbon technologies.

"We're beginning to see for the first time incubators not just being created by private companies that compete with the incubators from government but actually joining up the two," says Mr Reilly.

For start-ups, incubators offer a range of services, from physical space and support services, to access to professional services, expertise and introductions to funders: "And maybe most importantly, community," says Mr Kotch.

However, that community can also be a virtual one, argues Mr Esty. His state is launching an advanced energy innovation hub located at the University of Connecticut, initially focusing on the development of fuel cells.

Although the hub is located at the university, "the spokes will connect companies across the state and outside the university," says Mr Esty.

Incubators can also provide introductions to potential customers. For example, through its links with Con Edison, NY Acre was able to facilitate a partnership between the electricity

'Private sector partners are game changers if you can get in to their supply chain'

utility and ThinkEco to deploy modlets across New York to help manage the electrical load demanded in the summer by the city's 6.2m window-mounted air conditioners.

Meanwhile, for cash-strapped governments looking to maximise the impact of money spent on fostering clean energy, investing in incubator facilities offers a cheaper alternative to funding subsidies for renewable power and allows policy makers to make more informed decisions.

"If you allow governments to pick the winners, you have selection based not on prospects for economic success in the marketplace but too often based on political calculations," says Mr Esty.

Because investing in clean tech incubators means governments are following market capital, rather than trying to shape the market, it lowers the risk of selecting a technology that may ultimately prove not to be commercially viable.

"The principle that government money should follow private capital leadership is a better starting point," argues Mr Esty. "If you use limited government money to leverage private capital and piggyback on decisions being made in the marketplace, you have a much better strategy for success."

# The best things will come in smaller packages

## Recycling

### Reducing, improving and reusing material provides benefits for producer and buyer, says Jane Bird

Next spring, US shoppers will be able to buy a three-in-one cleaning fluid dispenser with a trigger nozzle. It has a twist mechanism that switches between the three concentrates, while the refillable handle contains water to dilute them as they are used.

Customers can choose their three cleansers from cartridges for glass, kitchen, bathroom, furniture and carpet.

"In trials, the initial problem was overcoming suspicion that it might be difficult to use or fail to work," says Kelly M. Semrau, chief sustainability officer of Wisconsin-based SC Johnson, which makes the SmartTwist. "But by the end, people didn't want to give them back."

The SmartTwist, in line with Johnson's efforts to make its packaging more sustainable, contains 64 per cent less plastic than a single 26oz trigger bottle, and the individual filled cartridges weigh up to 80 per cent less than their non-concentrated equivalent.

SC Johnson also met consumer scepticism when it tried to launch concentrated refill pouches for products such as Pledge, Shout and Windex. The pouches were designed to pour well but people did not believe they would.

Even though concentrates are lighter to transport, convincing people they are more convenient is a challenge, says Ms Semrau. "We changed to small plastic bottles, which people felt would pour more easily."

The other problem is price. People resent the fact that refills are not much cheaper than new dispensers. SC Johnson wants supermarkets to insist that all cleaning products should be concentrates, as they have with laundry products.

This would create the

volumes needed to reduce prices, says Ms Semrau.

Procter & Gamble is also trying to reduce plastic packaging. Together with the UK's Waste & Resources Action Programme (Wrap), it has developed software that models plastic bottles to work out where the stresses are.

Peter White, P&G's global sustainability director says: "It has enabled us to remove 14 per cent of plastic from detergent and beauty product bottles such as Olay, Lenor and Aerial."

P&G also plans to transfer 25 per cent of its 2010 volume of petrochemical materials to renewables by 2010. It has started using bio polyethylene from sugar cane for products such as Pantene.

Instead of emitting carbon dioxide, this material locks it in. Greenhouse gas emissions are reduced by more than 170 per cent and 70 per cent less fossil fuel is consumed.

P&G is using bamboo, bulrush and sugar cane fibres for Gillette Fusion ProGlide, cutting packaging



**Johnson's SmartTwist bottle**

weight by 20 per cent and plastic by 50 per cent.

Toy manufacturer Hasbro, which makes My Little Pony, has replaced 34,000 miles of wire ties in its packaging with paper ratan or bamboo mix ties.

However, the US is far behind Europe on sustainable packaging, says Nina Goodrich, director of the Sustainable Packaging Coalition, a Virginia-based industry working group.

Her view is shared by Conrad MacKerron, senior programme director of As

You Sow, a non-profit organisation that encourages shareholders to put pressure on US corporates to take responsibility for packaging waste.

In 1994, an EU directive required member states to develop regulations on prevention, reuse and recycling of packaging waste.

Mr MacKerron points out that this cut waste going to final disposal by 43 per cent, to 17m tonnes, in the decade to 2008.

In the UK, the grocery industry is on target to reduce the weight of packaging and increase its recycling to produce a 10 per cent cut in carbon usage in the three years to December 2012.

Among innovations that have helped meet the target is a gas permeable packaging film from Evap that extends the life of Jersey Royal potatoes from four days to eight. This reduces waste throughout the supply chain by 50 per cent, says Richard Swannell, Wrap's director of design and waste prevention.

Moy Park, the meat and poultry producer, has dis-

carded the plastic tray commonly used for whole chickens, in favour of film which hermetically seals the birds in a "modified atmosphere". This prolongs the product's shelf life from eight days to 10 and reduces packaging weight by 70 per cent.

Mr Swannell says it preserves food better, giving customers longer to use it, and reduces waste in the food chain. There has also been significant progress with coffee granule refills, such as those for Kraft Foods' Kenco, he says.

Home Retail Group has introduced a reusable bag that protects large items such as sofas and fitted kitchens during transport and can be removed on delivery. Such items are often protected with a lot of cardboard, plastic film and tape, says Mr Swannell.

Customers sometimes cause or discover damage when removing packaging. The reusable bags enable drivers to check goods are in good condition.

"This saves 1,800 tons of packaging a year and gives a better customer experience," says Mr Swannell.

# Beijing mounts push for increased energy from renewables

## China focus

### Developing more power sources is a strategic goal, reports Leslie Hook

When Danish enzyme maker Novozymes was looking for partners to help it make chemicals out of corn cobs, it came to China.

And when German solar panel maker Q-Cells was trying to sell a subsidiary that had developed a record-breaking technology for thin film solar panels, it found a buyer in China.

The world's largest

energy consumer can seem like a Mecca of clean energy development, with a level of state support and commercial enthusiasm for new technologies that is almost unparalleled. The world's biggest consumer of coal, thanks to the policies of the past decade, is now the world's biggest producer of solar panels, wind turbines, and electric batteries.

By 2015, Beijing aims for 30 per cent of China's generating capacity to come from non-fossil fuel sources, a government white paper published last month says. Clean energy is prized in China because it helps the country reduce its dependence on imported energy

sources and also contributes to lowering carbon emissions.

According to the white paper, the vision for 2015 includes 400 square kilometres of solar heat surface collection and 100 gigawatts of installed wind power. Developing new and renewable energy is a "key strategic measure" and an "urgent need in the protection of the environment", the white paper says.

"China's energy development must follow a path featuring high-tech content, low consumption of resources, less environmental pollution, satisfactory economic returns, as well as security," it adds.

That line of argument is part of the reason Novozymes has had such success in China. This year, Chinese chemical company Shengguan Group began commercial production of ethanol made from agricultural waste using enzymes provided by Novozymes. That product, known as cellulosic ethanol, gets special mention in the white paper, with other biofuels such as biodiesel.

China's electricity grid is set to be a key front for investment in clean energy technologies, as China's grid companies spend billions of dollars on developing a "smart grid". At present the electricity grid

acts as a constraint on wind and solar installations in many places where it cannot absorb the intermittent power supplied by solar or wind farms. The problem is so widespread that last year energy authorities slowed down the pace of wind installations, to give the grid more time to upgrade its systems.

China is building ultra high-voltage electricity lines to carry electricity from coal-rich regions, such as Inner Mongolia and Xinjiang, toward the areas of high energy demand on the eastern seaboard, so saving on energy for transport. Those conduits stretching across the country make

China the biggest builder of power lines anywhere in the world.

Fossil fuel sources will continue to be part of China's energy plan and the government is lending its support to other types of fossil fuel energy, such as shale gas and coal to gas technologies.

'China's energy development must follow a path of high-tech content'

White paper

"China needs stuff that scales," says David Michael, managing director at consultancy BCG in Beijing. "Anything related to natural gas, LNG supply, and shale gas is set to grow."

China announced a generous tariff for shale gas in November, creating a big economic incentive for companies to invest in exploration for the unconventional resource. Shale gas, extracted by fracturing rock deep underground and capturing the natural gas that escapes, has revolutionised the energy landscape in the US and China hopes to do the same.

As the country works to make a 40 per cent in car-

bon emissions by 2020 compared with 2005 levels, clean coal technologies are in the spotlight.

Coal plants and steel mills are investing in carbon capture technologies and processes that can reduce emissions of sulphur and nitrous oxide.

"Making coal cleaner mitigates the conflict between China's high-carbon energy sector and the goals of green growth," says an executive at Shenhua, China's biggest coal producer. Its coal consumption is set to grow but it will draw a smaller percentage of its power from coal, leaving room for clean energy technologies to grow.

## Sustainable Business Green Technology

## Sharing skills enhances likelihood of success

**Collaboration** Joint initiatives bring benefits, says *Mark Wembridge*

Universities and non-profit organisations have long expounded the benefits of collaboration in green technology to achieve a common goal but the spread of intercorporate projects has been less widespread.

Kris Gopalakrishnan, executive co-chairman of Infosys, the Indian information technology consultancy, says: "Companies can educate each other, supply funding, help boost a supply chain and push the project towards its goals."

"Through co-operation and the sharing of skills, innovation and resources from the private sector across various industries, the development of green technology will grow faster. Any new project could then become a new revenue stream."

But concerns over privacy, intellectual property and the compromise of commercial viability must all be tack-

led when two or more companies decide to throw in their lot together on a green technology project.

However, these issues can and have been overcome, as SSE, the British energy company, proved with a carbon capture project at its Ferrybridge power station in West Yorkshire.

Initiated late last year, the project was set up to capture 100 tonnes of carbon dioxide per day from the emissions of a five megawatt coal-fired power plant.

The green technology – often touted as a way of cleaning up after "dirty" fossil fuel power plants by preventing CO<sub>2</sub> from being released into the air – captures the gas and pipes it to storage deep beneath ground or sea.

The Ferrybridge project was a collaboration between SSE, Doosan Power Systems, which builds, maintains and extends the life of power plants; and Vattenfall, the Swedish energy company.

SSE's rationale was simple: the collaboration achieved the desired result faster than if it had gone ahead alone.

"The power of collaboration lies in bringing together companies who are real specialists in their respective fields to form a creative force that is greater than the sum of its parts, allowing them to achieve technological enhancements that may not otherwise have been possible," said SSE.

"We've also found a good cultural fit between organisations is crucial to the success of any collaboration."

As well as corporate partners, the project benefited from £6m of public funding and had the co-operation of the Northern Way, the body set up to bridge the productivity gap between the north and south of England, as well as the Technology Strategy Board, the UK innovations agency.

Although bringing so many partners together could have strained the scheme, the carbon capture project –



PET project: Continuum Recycling's plant turns out bottle grade plastic

The plant processes plastic packaging and turns it into materials that Coca-Cola can use to make drink bottles. The turnaround time from collection to a new bottle appearing on the shelves is as little as six weeks.

The partnership has created a template for Coca-Cola in other countries, with similar projects lined up for other markets, including France.

Other recent collaborative projects can be found in the US, where Heinz teamed up with Coca-Cola, Ford, Nike and Procter & Gamble to speed the development and use of plant-based plastics. All use the plastic PET polyethylene terephthalate in products such as plastic bottles, clothing, shoes and automotive fabric and carpet. Through the creation of the Plant PET Technology Collaborative, the five pooled their technologies and resources to increase the amount of plant-based plastics used in consumable bottles.

The group said: "PTC members are committed to researching and developing commercial solutions for PET plastic made entirely from plants and will aim to drive the development of common methodologies and standards for the use of plant-based plastic."

The role of government as an initiator of such corporate tie-ups should not be overlooked.

Mr Gopalakrishnan points out that the state plays an important role throughout each stage of the development of green technology. He says: "Government should work as a catalyst by helping to fund new technology, then by spreading best practices, then by acting as a regulator."

one of the first of its kind in the UK – has proved to be a litmus test for not only the green technology, but also corporate collaborations.

The project has provided valuable information for industry regulators, such as the Environment Agency, and SSE is considering broadening its collaborations into a larger scale operation at its gas-fired power station at Peterhead in Aberdeenshire.

The benefits of corporate collabora-

tion in green technology have not been restricted to power companies.

This year, Eco Plastics, the Lincolnshire-based recycling group, created a joint venture with Coca-Cola to increase the pace of development in the UK's recycling infrastructure.

In May, they opened the £15m Continuum Recycling plant, which has more than doubled the amount of bottle grade recycled plastic that was previously created in the UK.

## Stronger political will is needed

Continued from Page 1

\$280bn in 2011, more than five times the \$53bn total achieved in 2004, according to Bloomberg New Energy Finance.

Nor is innovation in this sector limited to small companies and start-ups. Clean tech's heavyweights include the world's largest corporations, many of which are making substantial investments in developing technologies that address everything from energy use to water conservation.

One route to doing so is to establish internal research and development centres. Yet companies are also becoming flexible in the way they promote innovation. This includes using web-based crowd sourcing or open innovation to identify clean tech entrepreneurs. While crowd sourcing allows companies looking for clean tech answers

Investment in clean energy continues, rising to a record \$280bn in 2011

to conduct searches among innovators across the world, globalisation of clean tech extends beyond open innovation.

For a start, as emerging economies expand, they will provide new markets for clean tech products. Meanwhile, green technology innovation is also shifting to these markets as they become aware that rising wealth leads to increased resource consumption and the potential for greater environmental degradation.

Many believe Latin America may become a leader in finding ways to deliver economic growth while protecting natural resources and establishing sustainable renewable energy supplies, as Brazil has by developing sugar cane ethanol as a biofuel.

In mature markets, while governments continue to invest in clean technology, some are changing tack to reflect budget constraints or shifts in the market.

A number of administrations – including the UK and Germany – are debating cutbacks in subsidies for renewable energy. On the other hand, new joint venture and technology transfer opportunities exist in China, which provides strong government support for a range of energy efficiency and renewable energy technologies.

Some policy makers are changing the way they spend government dollars. Rather than trying to shape the market, they are investing in clean energy incubators or establishing venture-capital funds to support entrepreneurs with ideas.

The focus of clean technology extends beyond energy. With the world's water supplies increasingly under pressure, finding methods of recycling and conserving supplies has risen up the agenda for public and private sectors.

And with waste management a problem for all organisations, many are looking for ways of turning waste into a resource or reducing packaging.

In the cement industry, the potential for cement furnaces to become incinerators for waste from steel plants and other facilities is prompting discussions of co-location of these plants – helping cement makers cut carbon emissions and contribute to waste management.

Plenty of ideas and workable models are emerging. Yet the question on the lips of all those who believe developing the clean tech sector is essential to the planet's future prosperity is how to bring about widespread use of green ideas and technologies.

The trouble is that, with some exceptions, many business models remain in the pilot stage or are limited to certain companies or industries.

Without increased collaboration between public, private and non-profit sectors, and willingness for companies to work together on environmental issues, many fear that green technology will fail to reach the scale needed to halt or reverse the environmental problems it is designed to solve.

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\*Source: A New Era of Sustainability, UN Global Compact-Accenture CEO Study 2010

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## Sustainable Business Green Technology



## Company on the track of an answer to e-waste riddle

### Electronics

There is economic value in sorting out the problem, asks Sarah Murray

When EMC was considering how to improve its disposal of electronic waste, it just so happened Kathrin Winkler, the information technology group's chief sustainability officer, was reading a book on iconoclasts. For her, the notion of destroying established conventions fitted perfectly with how she felt the company should approach the problem.

This was part of the reason that EMC, based in Massachusetts, decided to launch an online Eco-Challenge working with the Environmental Defense Fund and InnoCentive, the open innovation company. "Diversity of experience and perspective helps generate innovation," says Ms Winkler. "And I was taken with the idea of being able to reach out to innovators in other industries."

Through the Eco-Challenge, EMC wanted to find a system for tracking shipments of used electronic components and subsystems so that they could be disposed of responsibly.

Ms Winkler says: "E-waste is a social, economic and environmental issue. It ends up in landfill or in the developing world, hurting people in the informal economy who extract the raw materials. "And there's true economic value locked up in there, so it makes sense to address all this together."

As with any company in the electronics sector, the problem EMC was grappling with lay in the complexity of technology.

Electronic equipment is made up of many components – often tiny in size – making it difficult to label or track every part.

The Eco-Challenge asked participants to come up with a process or device that would track the passage of waste items – from computers to mobile phones and television sets – from where they had been used to final disposal.

With a \$10,000 prize offered, the challenge prompted almost 800 individuals and companies to work on the problem, with

more than 60 entries submitted.

Three winners were selected. One used passive radio frequency identification ink, another combined electronic identification with an online crowdsourcing platform to create a holistic picture of the components and the third used labels printed with unique encrypted codes for each major component in the system.

"The three each potentially have a piece of the solution but no one completely solves it," explains Ms Winkler. She says EMC is inviting the winners to work with it to explore how the three solutions might be combined.

EMC wants to find a solution to help manage not only its own e-waste more responsibly but that of the entire sector.

For this reason, the crowdsourcing approach was particularly appropriate as an R&D tool, unlike other developments, where open innovation might risk loss of intellectual property.

Gwen Ruta, who directs

The nature of many environmental concerns makes them well suited to open innovation

the corporate partnerships programme at the EDF organisation, says the non-competitive nature of many environmental problems makes them well suited to open innovation.

"And e-waste is a good example," she says. "It's a problem that affects your business but being able to solve it helps everyone's business equally."

The complexity of the electronics supply chain means that companies like EMC rely on a deeply intertwined web of suppliers – and the same applies to the reverse supply chain in the collection and disposal of e-waste.

Any system that can be used across the industry will therefore generate economies of scale.

"We'd like to see the overall system change," says Mr Winkler. "In most cases a good solution isn't going to scale economically if it only serves one company."

## Fresh eyes may resolve dilemmas

Innovation Business and NGOs harness the power of networking to find expert help, writes Sarah Murray

As well as attending seminars and networking events, visitors to this week's GreenBuild expo in San Francisco can watch a "speed dating" session during which executives from Saint-Gobain, the French building materials group, will choose three winning ideas based on the strength of 10-minute pitches.

The session – part of an approach the company calls "outovation" – is one of many open innovation methods being used to find clean tech ideas.

"Quite simply, a fresh set of eyes can come up with an answer," says Gwen Ruta, who directs the corporate partnerships programme at Environmental Defense Fund, the US-based environmental group.

Last year, EDF launched a partnership with InnoCentive, an online open innovation company, to speed up environmental innovation in business. Ms Ruta says: "If you've got a stubborn environmental problem that you've been working on internally, maybe you can make more progress by opening it up externally."

This has been Saint-Gobain's experience. Rakesh Kapoor, the company's North America director of research and development says: "Any of us – particularly in large companies – can become very inward looking. But a breakthrough can come from anywhere, so we're trying to set up systems where we're looking to the outside for technology." The Saint-Gobain competition – which has been

running for several years – has allowed the company to identify a range of new ideas.

This year the eight finalists – from early stage start-ups to well-established entrepreneurs – have proposals that include an eco-friendly resin for building materials, self-shading smart windows and thin-film coating equipment that makes products such as LED lights and photovoltaics more durable and cheaper to manufacture.

Mr Kapoor, who is also director of NOVA External Venturing, a unit through which Saint-Gobain develops

'If you've got a stubborn environmental problem you can make progress by opening it up externally'

partnerships with start-ups, finds it refreshing to see such ideas emerge.

He says: "When you work in a similar line of business for a long time, you think you've got the world figured out. But the world is always three steps ahead and someone else looking at the same reality might look at it differently."

This is what motivated EDF to form its partnership with InnoCentive.

Companies working with EDF and InnoCentive can identify stubborn environmental problems, formulate

them as "Eco-Challenges", post them online and offer financial rewards for the most promising solutions.

Companies are not alone in looking to source ideas from across the world. Open innovation is moving into the non-profit and development world. UK-based Skippo, a global network of clean tech experts, investors and service providers, helped a Swiss non-governmental organisation that wanted to find a way to electrify a village in Rwanda using renewable energy. Mr Kapoor says: "In just a few weeks they were able to source experts from all over the world and select a winner, an engineer from a Spanish company."

The United States Agency for International Development is looking externally for ideas. Its Grand Challenges in Global Development are designed to find a broad range of solutions to development issues, including access to clean technologies.

In June, for example, USAID launched a challenge inviting innovators to find new ways to deliver clean energy to smallholder farmers across the developing world.

Rajiv Shah, USAID administrator, says: "The Grand Challenges allow the development agency to cast its net wide when searching for solutions."

"Whereas a traditional aid effort might get six to 10 proposals on a project idea, each of these challenges have had 600 plus incoming," he says.

"More than half are from the developing world itself and more than 30

per cent are from the private sector."

It is this ability to tap into the expertise of a range of sectors and organisations that those looking for new clean tech products and services find compelling about the open innovation model.

However, when it comes to reaching as many clean tech entrepreneurs and experts as possible, web-based crowdsourcing models have the greatest potential. "With a few key strokes, you can tap into the scientific community around the world," says Ms Ruta.

This is particularly helpful in the clean tech sphere. Carlo Soresina is co-founder of Skippo, which was set up in 2008 to unite the fragmented community of clean tech entrepreneurs and experts. He says: "Unlike ICT [information and communication technology], where you have a lot of innovation coming out of Silicon Valley, clean tech is much more broadly distributed geographically."

To be successful, the challenges need to be formulated in the right way. If the problem is set too broadly, a deluge of responses can make it hard to identify promising solutions.

Yet defining it too narrowly could deter those who might in fact have ideas with the potential for success.

And soliciting ideas from unexpected quarters is a key advantage of crowd-sourcing. Mr Soresina says: "Often the best solutions come from experts in a completely different field or an adjacent community."

## Carbon capture is an opportunity ripe for exploitation

### Energy

The processes work but official incentives are few, reports Ed Crooks

A few years ago there was an advertisement shown on US television opposing controls on greenhouse gases that ended with the words: "Carbon dioxide. They call it pollution; we call it life."

The advert was derided by environmental campaigners for its cynical obfuscation of the reasons why anyone might be concerned about CO<sub>2</sub>. Yet it pointed to what now looks like one of the most promising approaches to addressing the threat of climate change – seeing carbon dioxide not as a problem to be solved but as an opportunity to be exploited.

If the world is to put long-term limits on greenhouse gases in the atmosphere, then capturing and storing the emissions from burning fossil fuels seems essential. Oil, gas and coal provide about 80 per cent of the world's energy and it is difficult to see how they will not continue to be indispensable for decades to come.

Managing their greenhouse gas emissions, however, is extremely difficult. Switching power generation

from coal to natural gas, which creates roughly half the emissions per megawatt hour of electricity, has had some impressive effects in the US but there are limits on how much progress can be made.

The International Energy Agency, the watchdog backed by rich countries' governments, warned this year that a "Golden Age of gas", in which abundant reserves of shale gas worldwide are being unlocked by advances in production techniques, would result in global temperatures rising by 3.5 degrees C.

However, the development of technologies for carbon capture has been plagued with delays and setbacks.

In Britain, for example, the government announced at the end of October a shortlist of four carbon capture projects potentially eligible for £1bn of funding. That was more than four years after the previous government decided on its shortlist of four. Having wanted to see commercial carbon capture plants in operation "by 2020", the UK is now talking about that goal "in the 2020s".

Projects have been shelved in the US, Canada, the Netherlands and several other countries.

The Global CCS Institute, the international think-tank that brings together govern-

ments and the industry to push for more progress, said in October that in the preceding 12 months nine new projects had been launched but eight had been cancelled.

It warned: "It is clear a very substantial increase in new projects needs to occur" to keep carbon dioxide emissions at levels that would make it likely the rise in global temperatures could be kept within acceptable limits.

The problem is not so much that carbon capture is a new technology – all the elements of the process are in use today – as that it is difficult and expensive to manage at a large scale.

Without clear economic incentives, companies will not invest in the technology and, with finances strained in both the public and private sectors across the developed world, it is hard for governments to provide those incentives.

As a result, the greatest progress in carbon capture is now being made on projects where the carbon dioxide is used for some other purpose, most often enhanced oil recovery.

Since the 1970s oil companies have been injecting carbon dioxide into reservoirs to squeeze out more crude. In Texas, they pay about \$30 per tonne to get it, largely from natural sources.

That is still less than the cost of capturing carbon using many of the methods available but there are widespread hopes that the costs can fall.

General Electric and Sargas of Norway this year launched a joint venture to sell gas-fired power plants that would capture 90 per cent of their CO<sub>2</sub> emissions, for a cost that they hope will be well below that \$30 per tonne.

In the meantime, companies are pushing with carbon capture projects for oil recovery with the help of government support.

Seattle-based Summit Power has been making progress with the Texas Clean Energy Project (TCEP), a 400MW coal-fired power plant to be built in west Texas, that will produce about 3m tons of CO<sub>2</sub> per year to be used for oil recovery. The project was given a \$450m grant by the US department of energy.

Georgia-based Southern Company is building a coal-fired plant with carbon capture at Kemper, Mississippi, again for use in oil recovery. Like the TCEP, the technology involves gasification of the coal and then burning the gas. Southern and its partner KBR, the civil engineering contractor, are marketing the technology around the world as a way to provide "clean, safe, reliable and affordable

Clean coal: a carbon capture unit at Longannet power station, Scotland  
Getty



While the technology is not new, it is difficult and expensive to manage

energy produced by an abundant and underutilised coal resource", with the sale of the CO<sub>2</sub> helping to keep the cost down.

There is not enough demand from the global oil industry to provide a market for all the CO<sub>2</sub> produced by the world's power plants but environmental groups such as the Clean Air Task Force argue that by making carbon capture more commercially attractive, enhanced oil recovery could shave a vital five or 10 years off the time needed to make it an efficient technology.

However, there is another approach that is potentially even more interesting. Skyonic, another Texas-based company backed by venture capital as well as BP and ConocoPhillips, the oil companies, is developing a technology to capture CO<sub>2</sub> from industrial waste gases and to mineralise it into carbonate and b-carbonates that have a commercial value.

The process can be retrofitted to existing plants and requires no underground storage of CO<sub>2</sub>, which has often proved controversial.

It is early days yet but if the process can be made to work on a large scale at a reasonable cost, it could play an important role in enabling the world to continue using fossil fuels, while avoiding the worst of their effects.