THE GREAT LEAP FORWARDS

TECHNOLOGICAL BREAKTHROUGHS AND NEW SCIENTIFIC DISCOVERIES COULD HAVE A MAJOR PART TO PLAY IN FORGING A SUSTAINABLE FUTURE.

WORDS BY **KEVIN GOPAL**

Fresh out of the shower and it's time for the daily health check. Sensors capture your vital signs and relay them to the local health centre. Thirty seconds later the all clear comes through on a plasma screen in your bathroom - but if there had been problems, the right medicines would have been ordered, tailored specifically to your genetic make-up.

Then it's time to go to work. As operations manager of a large manufacturing firm you have huge responsibilities - even though nanotechnology means your factory is so small that it sits on a table downstairs.

And if you do have to pop out and visit clients, the car runs on hydrogen that has been converted from methane or another greenhouse gas.

Predicting the major technological leaps that will shape our future is notoriously fraught. The futurologists of the 1960s had us believe that we would all be wearing unisex catsuits, eating gourmet meals in a pill and getting around on souped-up jetskis. That future never happened.

And in terms of sustainable development, some argue that the future isn't about technological breakthroughs anyway, it's about incremental improvements and social changes.

Research in the Northwest suggests that we shouldn't dismiss the potential of the Great Leap Forward. Researchers at Manchester University, for example, are examining the use of plasma technology to reform methane into hydrogen that can be used to power vehicles and other devices. The reduced environmental impact of hydrogen as a source of power is already well-documented: the ability to make that hydrogen from greenhouse gases adds a whole new dimension of benefits.

Dr Christopher Whitehead of Manchester University's Chemistry Department is part of a team working on plasma-based methods for cleaning diesel exhaust gases, tackling waste solvent streams and removing CFCs. His team has a plasma-based device for cleaning up air that is undergoing commercial trials and should be going to healthcare, domestic and commercial air purification markets within a year.

Using plasma technology to convert methane to hydrogen is a future goal for the team according to Whitehead: "All this feeds into alternative energy sources that are kinder on the environment in terms of emission of greenhouse gases, with all the resulting climate change consequences. The hydrogen economy is a move from fossil fuels."

Professor Ian Miles, director of Policy Research in Engineering, Science and Technology (PREST) at Manchester University, distinguishes between incremental innovations (which sometimes increase the use of resources), radical ones based on new ways of doing things or new technical knowledge, and revolutionary ones, where the knowledge is so fundamental that it can be applied across a range of social and economic activities. He says: "Of the latter, we could see steam and electric power as examples, IT more recently. We are beginning to realise just how pervasive biotech is, and nano is just beginning to pop its head up.

"My view is that the IT revolution still has a long way to go. Bio and nano are newer, and thus more unpredictable. They have applications well beyond health, food and materials areas. For example, new energy systems might be based on nano materials that mimic biological systems' capturing of solar power or on GMO crops that provide fuels or new materials that act as much better solar cells, refrigerants or superconductors. Remediation of contaminated land may be achieved by GMOs or small robots."

The leap from commercialising microtechnology to using nanotechnology is huge, but as Richard Worsley, director of the Tomorrow Project (a charity investigating how people's lives might look in 20 years), points out, there is already a huge amount of investment going into the process of manipulating materials at a molecular level.

Laptops the size of fingernails and portable equipment and plant are in the offing says Worsley, and there's the possibility of factories the size of tabletops. "This is hugely important for the way that houses and factories are formed."

Worsley believes that the combination of IT, biotechnology and nanotechnology will be a fertile source of breakthroughs. Biotechnology offers the possibility of transforming drug therapy from what he calls the "optimistic shotgun" approach to one that is more closely targeted at the condition in question and tailored to individuals' responses.

Healthcare advances also depend on technology to monitor and record patients' conditions and a revolutionary piece of hospital equipment has been developed in a partnership led by Bolton Institute's Technology Development Centre. The Pippa Breathing Monitor harnesses pyroelectronic polymers (PEP) technology to create a device which can continuously monitor patient breathing and alert hospital staff in a medical emergency.

A joint venture company, c-Lect medical, has been created between Bolton Institute and a local company, Smart Ideas (rSi). Plans to market the sensor are now at an advanced stage and a distribution agreement has been signed with Viamed, a medical equipment specialist.

All this research takes place in a context of growing public and media concern about the risks of science. Critics of GM foods, among others, have suggested we ought to be keener to apply the precautionary principle - first do no harm - before further development. What's more, military and corporate control of technology can give cause for concern, as can the potential for abuse of everything from aircraft - as in the 9/11 attacks - to IT systems, to, in the future, genetic material.

WE NEED TO THINK SERIOUSLY ABOUT WAYS OF ANTICIPATING THREATS AS WELL AS TALKING UP THESE REAL OPPORTUNITIES

Miles argues that the precautionary principle is very difficult to apply to many innovations because their long-term implications are hard to assess and because the innovations "are themselves on the move, with incremental and radical change a fact of life".

"On the other hand, I see the benefits of further knowledge to be so immense and commercially attractive that the case for further developing the new technologies is overwhelming," says Miles. "We need to think seriously about ways of anticipating threats as well as talking up these real opportunities."

And as Worsley says, controversially perhaps: "There will always be risks in rolling out science. Too much precautionary principle and we could have been afraid of electricity."


HYDROCAR

A NEW KIND OF CONSTRUCTION IS RESHAPING OUR SKYLINES AND REDEFINING THE MODERN HOME. GREEN BUILDING SCHEMES THAT BOAST ARGON-FILLED GLAZING, GREY WATER RECYCLING AND INTEGRATED RENEWABLE ENERGY SYSTEMS ARE BUSY SETTING A NEW BENCHMARK FOR BUILDING DESIGN.

WORDS BY **PHIL GRIFFIN**

BUILDING NEW BENCHMARKS

Taylor Woodrow is not best known for environmentally-friendly buildings. Nor, if it comes to that, is the architect Sir Terry Farrell. So the Green Building in Macintosh Village at Manchester's newly designated Southern Gateway could be a revelation. Certainly green is the colour that would have suited the previous inhabitants of this place. Between 1847 and 1877, it was a low-lying sprawl of 200 or so dwellings marooned in a bend of the River Medlock. It was home to some 4,000 people and was known as Little Ireland. It was a notorious slum. According to the brochure, the Green Building is '32 light, bright and flexible one and two-bedroom apartments and penthouses... available with a bike store and nursery.'

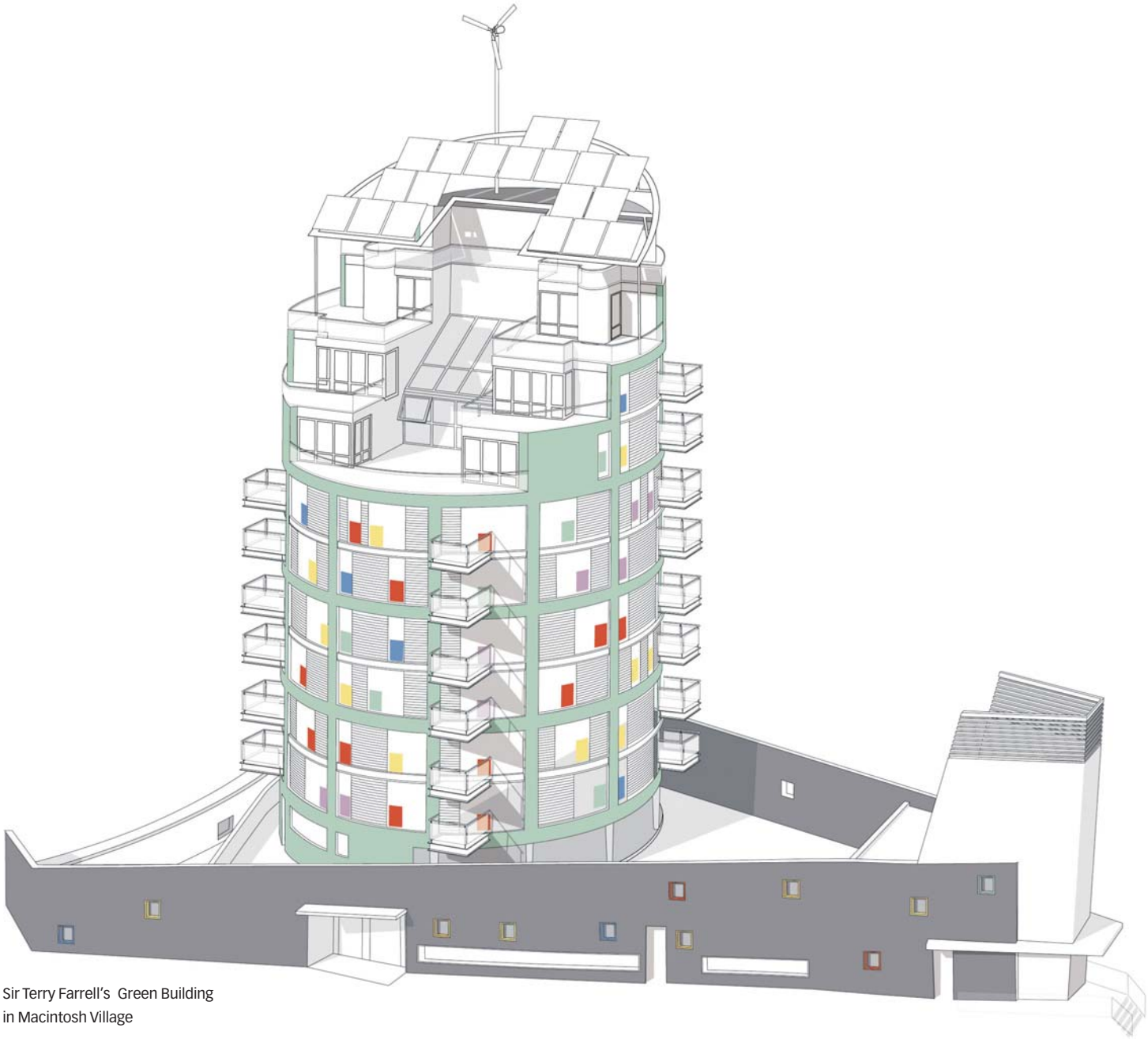
Property developers, like supermarkets before them, have spotted the potential in a small but fast-growing market for environmentally-friendly products. When homebuyers start to question the ecological credibility of what is on offer, the world has turned a notch. Some people want to take care of themselves and their environment. They want to recycle the bath water, reduce carbon emissions, adopt renewable sources of energy, sort their waste, identify the chemistry and geography of the materials their homes are made from, and actively affect how developers and architects respond to glaringly obvious global bad practice. They will look for more sensitive building schemes. They are a niche market.

In December 1999 Irwell Valley Housing Association launched by invitation an architectural competition for a pocket-site three miles south of Manchester city centre in a suburb called Chorlton. Irwell Valley was looking to build 21 shared ownership apartments on the badly contaminated site of a 60-year-old petrol station. They took the competition route because directors Phil Summers and Fiona McAuley were totally committed to regeneration through strong, contemporary design linked to sustainability. They have always attempted to shake up the social housing sector. In 1997, Fiona was responsible for Rona Walk in Openshaw, the only scheme in Manchester that has received the BREEAM (Building Research Establishment Environmental Assessment Method) award for sustainable construction.

Tom Bloxham is chairman of private developer Urban Splash. He was invited onto the judging panel for Chorlton Park. Manchester architects Stephenson-Bell won the competition. The project architect is David Simister: "Tom Bloxham had a real impact on the scheme. He liked what we came up with and asked if Urban Splash could be involved. They added six apartments for outright sale to the 20 shared ownership. Effectively, it meant that we could ease our build costs, and put 27 parking spaces below ground, which isn't very green, but is secure."

The scheme was completed in 2002. The key to Chorlton Park is orientation and insulation. David Simister explains: "Our major consideration was energy conservation and not renewables. It seems to me that if the house is going to stand for 60 years, when you conserve energy it is for that period. If in the present day you set out to generate renewable energy as part of your design, you risk capital going into untested innovations, the product of which will only improve and become cheaper. I spoke about this scheme at the BRE (Building Research Establishment) conference and a senior scientist pointed out that photovoltaics, even with a 50% grant, and at roughly £8,000 per unit, do not pay for themselves in 30 years. They could be added to a scheme such as Chorlton Park when they are cheaper and more efficient."

Fiona McAuley and Phil Summers set up their own development company in June 2002. R-Gen is committed to the highest standards of contemporary design combined with green technology and best ecological practice.



Sir Terry Farrell's Green Building
in Macintosh Village

The first of three pilot schemes began site clearance in August 2003. It is the site of an old pub called the Little Alex on the corner of Alexandra Road and Moss Lane East in Moss Side. Phil says the site is important in defining what they want R-Gen to be. "We've always been about regeneration. We believe that through carefully selected pilot schemes it is possible to create niche projects that will act as a catalyst for wider socio-economic regeneration. And we can still make money. The extra capital cost of building green is reducing."

The Little Alex scheme ticks all the boxes - as little plastic as possible, photovoltaics, grey water, natural gas filled, triple glazed windows, locally sourced, naturally replenished wood, and recycled materials (where feasible). "We know there must be some compromises, but we will not make them on cost. We'll build at £100 per square foot and we'll sell at affordable prices to individual owner-occupiers. We've been approached by several investors who want to buy up the entire scheme, but that's not what we are in it for."

David Simister knew all about unit costs at Chorlton Park: "We avoided spending £1600 on central heating by spending it on the insulation. The overall U value is 0.11. The heat load is 1.25kW, so there's a 1kW heater in the living room and a 0.25kW heater in the bedroom, and heating bills ought only to be tens of pounds a year. We struggled with the cost plan to keep high quality windows and doors because of air tightness. We've got fairly well-specified Velfac units with low-E glass and argon-filled cavities. Oh, and 22 tonnes of French windfallen oak." The timber forms the huge balcony frame that transforms the building from a neat 1930s modernist white box into something greener. Phil Summers is not overly impressed: "That's oak that travelled from France. How sustainable is that?" He also notes that Farrell's Green Building specifies cedar wood panels. "They'll be from Canada, no doubt."

Some things do get greener over time. Between 1959 and 1961 four Italian men of he same family laid 12 million individual hand-made pieces of mosaic on the 23-storey lift tower of the CIS headquarters building in Manchester. It is just beginning to fail and plans are being developed to clad the tower in photovoltaic panels, which will provide power to the buildingg's 4,000 occupants.. Italian craftsmen proved their worth, and now, for better or worse, it is time for new technologies to step forward. The building has been a paragon of its time and the new cladding will, at the very least, demonstrate an emergent technology as it replaces an ancient craft. And there is much more to come. The Budenberg Haus Project in Cheshire is an Urban Splash development of 330 apartments designed by Foster and Partners and Arkheion. They have combined heat and power and building management is via broadband. New Islington is the UK's third Millennium Community. It replaces a dilapidated 1970s council estate in Ancoats, East Manchester. The strategic framework is by Will Alsop Architects and the lead developer, once again, is Urban Splash. Ambitions for the 1500 dwellings include CHP, on-site sewage processing, brown water, grey water and ground water from boar-holes. Will Alsop is staking a claim for sustainability again with his Fourth Grace 'Cloud' on Merseyside, where there are plans for natural ventilation and a cooling system that utilises water from the River Mersey.

There may be no hay-bale houses, and these schemes may not meet the exacting standards of those such as BedZed in London and Hocketon in Nottinghamshire, but it is worth pointing out that these projects have largely been social housing schemes with significant amounts of public money. What may turn out to be significant about the next step on the road to sustainability is that the by-road turns into a highway. Passive ventilation is preferred to air conditioning in growing numbers of schemes. Green M & E consultants are in demand. It is as if the first shelf of organic veg has just appeared at the back of the store. Why does a volume house-builder such as Taylor Woodrow choose to specify one Green Building in the middle of a development that otherwise is not? Surely that's a bit like taking one bottle to the bottle bank after the party and leaving two bin-liners full for the bin-men?

American architect-philosopher Buckminster Fuller said, "waste is a resource in the wrong place." His argument holds good, even if it is yet to win the day. R-gen is not the only developer who will attempt to prove to funders that there is a sizeable and realistic market for sustainable buildings. There have been conferences and journals, books and reports that build the case for sustainable practice. What seems to be important now is that niche developments begin to grow the market. Not every green building needs a windmill. Ask the people in Chorlton Park. Stephenson-Bell's building is a new benchmark which hundreds will follow.

PROPERTY DEVELOPERS, LIKE SUPERMARKETS BEFORE THEM, HAVE SPOTTED THE POTENTIAL IN A SMALL BUT FAST-GROWING MARKET FOR ENVIRONMENTALLY-FRIENDLY PRODUCTS.

Stephenson Bell's award-winning
Chorlton Park development

They are the vanguard of our new evolution and a 24,000-strong force of the brave and the resourceful. They are the army of consultants, researchers, technicians and experts that have brought fish back to our waters, remediated our contaminated land and are helping us to generate new, clean energy. Enter the...

HEROES OF THE IND

USTRIAL EVOLUTION

IT'S AN INDUSTRIAL SECTOR WORTH BILLIONS AND IS SET TO GROW EXPONENTIALLY. IT KEEPS OUR WATER CLEAN, OUR AIR BREATHABLE AND IS BREAKING NEW GROUND IN RENEWABLE ENERGY GENERATION. WELCOME TO THE WORLD OF ENVIRONMENTAL TECHNOLOGIES WHERE GOOD IDEAS AND SOLID, SUSTAINABLE SCIENCE ARE BRINGING NEW JOBS AND NEW OPPORTUNITIES TO ENGLAND'S NORTHWEST.

WORDS BY **MARK HILLSDON**

Recycled toilet paper and planting trees. These, says Jackie Seddon, chief executive of Envirolink Northwest, are many people's perceptions of the environmental technologies and services (ETS) sector. In reality, of course, it is a cluster of industries that is harnessing the latest technology to find solutions to a host of environmental problems, from wastewater to nuclear decommissioning, and from air pollution to the remediation of contaminated land.

"The problem we have," says Seddon, "is that too many people, many in high-powered positions, do not understand this industry and have not grasped its potential. If we don't do something about capturing this global market and getting a grip on it, the industry in the region will fail."

Of course, failure is inconceivable. Globally the ETS sector is estimated to be worth $515bn, a figure comparable to both the pharmaceuticals and aerospace industries. In England's Northwest the sector is estimated to have 0.3 per cent of this global market share, worth $1.3bn.

It is a sector that is buoyant and which is growing, yet to many it is also invisible, a fuzzy area somewhere between tree hugging and wind farms. It's a confused profile and one that Seddon wants to change, with the Northwest becoming the hub of ETS activity in the UK.

Within the sector, the small and medium-sized enterprise (SME) is king. Successful companies are small, compact and high-tech, with highly-trained staff, many of whom have the business acumen needed for continued success.

"These companies cover a whole raft of things and that's what's so clever," says Seddon. "They are a small band but they flex across so many areas - from technology transfer to product development and the appliance of science and technology. That's what's smart about them - they are small, dynamic and innovative."

And the market for these businesses is growing as both companies and individuals wake up to the idea that they need to manage the negative impact of a highly consumer-based society that is stretching our planet's carrying capacity. "Sustainable development is now on everyone's agenda," continues Seddon, "whether they're in the public sector, the private sector, or in government. It's a global topic."

"People want to understand what sustainable development means, and grasp the fact that the economic part of our lives has a huge impact on the environmental part... People are asking questions and people want solutions, and the ETS sector has a massive part to play."

FEAR, NOT PHILANTHROPY, DRIVES MANY

to seek environmental solutions. Legislation has always been a major driver within the ETS sector and while some will 'ask questions' because they actually care about what kind of world their grandchildren are going to live in, others are active because they know that if they don't comply with legislation they will be prosecuted, which will affect their reputation and ultimately the value of their shares.

Joe Dwek, the former managing director of Bodycote International, agrees. He's a businessman who sees the environment as a sound business investment and now runs a string of businesses linked to the sector. He also sits on the DTI's new Environmental Innovations Advisory Group. "As more and more directives come out of Brussels, then the industry is set to grow," he explains. "People's intuition and inventiveness are being turned dramatically to solving (environmental) problems, but if there wasn't legislation, then you wouldn't have that urgency."

"Without the legislation, a lot of the ideas… would not be funded because you wouldn't have the market."

Sustainable solutions > The areas of environmental expertise covered in the Northwest include: air pollution control; contaminated land remediation; landscape services; marine pollution; noise and vibration control; recovery and recycling; transport pollution control; waste management; water & wastewater treatment; energy management; renewable energy; environmental consultancy; and environmental monitoring & analysis.

IT IS A SECTOR THAT IS BUOYANT AND WHICH IS GROWING, YET TO MANY IT IS ALSO INVISIBLE, A FUZZY AREA SOMEWHERE BETWEEN TREE HUGGING AND WIND FARMS

Ged Barlow, managing director of Cumbria based C-Tech Innovation, also sits on the DTI's advisory group. His company specialises in developing environmental products and services and then finding partners to exploit the product's potential. He agrees on the importance of legislation, but believes funding is another key to unlocking the sector's potential. "Technologies need to be fast-tracked now, otherwise we are going to have the same situation that we have with fridges, where a mountain builds up and UK companies are forced to import technology from overseas, and we effectively miss an opportunity to put our own house in order."

Barlow argues that 'sustainable procurement' would further stimulate the market with organisations such as local government purchasing more recycled products and ensuring they only dealt with suppliers who are heavily involved in recycling.

But many businesses still see the environment as an add-on cost, an overhead they are happy to resist. Only the enlightened few see it as an investment. "Historically the whole ETS sector has been seen as a service provider in response to punitive taxation or punitive legislation," says Barlow. "What the sector needs to do is to pitch itself as a sector which can address cost saving opportunities."

Envirolink Northwest > Envirolink is the Northwest Development Agency (NWDA) funded organisation whose aim is to develop the region's environmental technology sector by making it a competitive force to provide sustainable solutions to environmental problems. Its aims and objectives are to: improve the environment of the Northwest; raise the profile of the Northwest's environmental technologies and services sector in local, national and global markets; help the Northwest's environmental suppliers find and win new business; stimulate the formation of partnerships and consortia to address market opportunities; provide a forum for exchange of knowledge and experience; improve the competitiveness of the sector; and develop links with the Northwest Development Agency and other regional/national bodies.

"The clever companies see that investing in environmental technologies actually saves them money," says Seddon. For the past nine years, she explains, one Northwest textile company had been paying up to £240,000 a year to have its wastewater treated by another organisation. But they were oblivious to the other options they had, such as installing their own treatment equipment. This they eventually did, and for an outlay of £180,000, the company was enjoying payback within 10 months. "At first all they saw was more red tape, but when you put it as a case for good business, they were persuaded," she says.

Save money and you safeguard jobs - another value added by the ETS companies. But the sector is set to create jobs too. With 185,000 employees, it's already one of the region's biggest employers, and as the Northwest's traditional industries, like aerospace, car manufacturing and engineering, continue to decline, new industries are needed to replace the jobs that are being lost.

Take car manufacturing, which has been downsizing for decades. A number of Northwest companies are developing leading niche technologies in response to the End of Life Vehicle directive which puts an emphasis on recycling old cars rather than simply trashing them. And this opens up the intriguing possibility of people moving from car manufacturing to car recycling.

SO WHAT ARE THE BARRIERS to moving forward? Funding is top of the list. Part of Dwek's role through the DTI is to assess the merits of new ideas and whether they should receive 'seedcorn' funding. "There must be plenty of people with ideas out there who haven't got the funds or the commerciality," he says. "Some of them will be inventors in sheds, but these ideas can make tomorrow's great companies."

Barlow believes the need for funding goes further. "One of the biggest areas that we find problematic for companies trying to develop new environmental technologies is the availability of funding for pre-commercial demonstration projects," he says. It's a problem he believes could be solved with a new public/private partnership fund set-up specifically to help with the demonstration of new innovative technologies. This could help the region establish dedicated facilities to support businesses, helping them to find the next level of funding and ultimately remove another barrier to the innovation process.

Good ideas, of course, need good people to bring them to life and to market. This means that the sector's profile with young people and universities also needs to change. "With the number of skilled and talented young people diminishing, it's even more important that we attract them into environmental industries," says Seddon. "To have world class products, we need world class people."

Another key aim of the new DTI advisory group is to put academics in touch with industrialists, and give a greater commercial reality to the new technologies. "If we are going to have these businesses, we are going to have to have the skills to go with them," says Dwek. "Education has to be part of it."

"We know that the universities in the region are great at science and technology," says Seddon. "Where they need a helping hand is getting this out to industry. If we continue to build links, then this will translate into new products and services which will help us to maintain a leading edge, and bring in more inward investors."

And then there is the issue of exploiting international markets. "The international market for environmental technology is huge," says Dwek, "but the UK is not part of it. Why? Because the home base is not sufficiently strong. People can't export without having a good home base from which to operate."

PART OF THE PROBLEM IS A MISCONCEPTION about some of the products produced by ETS industries, continues Dwek: they don't always sit well with the green lobby. Yet many of these products, such as certain types of incinerators, are perfectly sustainable and environmentally-friendly. "We've got to change this attitude," he says, "then we can start developing and building our own versions of this machinery, and then we can export it."

Global growth > According to the Department of Trade and Industry, the world market for environmental goods and services is worth US$515 billion. This figure will grow to US$688 billion by 2010 - an annual growth rate of almost 3%.

Sector strength > The environmental technologies and services sector in the Northwest includes more than 700 companies. They employ around 24,000 people, making the sector larger than many others such as software development, construction and aerospace. The sector's annual sales total more than £1.3 billion.

The region's ETS sector does, however, have an impressive roster of international customers and is making moves to increase its share of a global market for environmental technologies that is forecast to grow to US$688 billion by 2010. Trade Partners UK have been working with Envirolink to make sure companies have the basic building blocks they need to start trading overseas. A series of events recently looked at possibilities in China, and this initiative is set to expand with a series of 'meet the buyer' events.

"This sector is becoming a priority in many of the overseas markets that we are targeting," says Paul Read, a regional operations manager at Trade Partners UK. "So we are looking to try and match the two things up, seeing where the opportunities lie in overseas markets, and then trying to push people in those directions."

According to Seddon, the ETS industries are becoming more and more powerful because they can impact on so many different areas of our economy and our society. "At our most basic, we start by cleaning up the damaged environment with new and improving technologies," she explains, "but then we work with existing sectors to help them improve their environmental performance so that, in the case of land remediation for example, we don't simply recontaminate our land. At the same time we are saving these companies money which safeguards jobs, and that in turn creates more business for the environmental industries."

IT'S A WIN ON ALL SIDES IN A GLOBAL market that's growing. The environmental sector is in the ascendancy, its potential is huge and, for all but the most blinkered, it's about a lot more than recycled loo roll.

THE LEGACY OF INDUSTRY HAS LEFT ENGLAND'S NORTHWEST WITH A SWATHE OF POLLUTED LAND THAT NEEDS CLEANING UP AND DECONTAMINATING. NOW, EXPERTS RIGHT ACROSS THE REGION ARE PIONEERING NEW TECHNOLOGIES AND SCIENTIFIC SOLUTIONS THAT USE LIVING, BIOLOGICAL PROCESSES TO BREATHE NEW LIFE INTO OUR POST-INDUSTRIAL LAND.

WORDS BY **KEVIN GOPAL**

NATURAL REMEDIES

When it comes to cleaning up we rival the best in the world, and with good reason. The industrial revolution - that steam-driven, rivet-driving epoch into which we led the world - left our region with one quarter of all the derelict land in England, much of it heavily contaminated. Particular hotspots include the chemical industry heartlands of Runcorn and Widnes where up to 80 per cent of land is polluted.

So far, so bad, but you can't keep a good region down. And you can't stop us turning a dirty legacy to our advantage either. Out of the ashes and the tar pools and the disused sites has grown a strong cluster of waste management businesses and land regeneration experts for whom contaminated land cleanups are commonplace. After years of sorting out our own problems, we specialise globally in remediating the kind of land we were left with, and, as regulatory frameworks draw ever tighter, the region even has a growing share of lawyers who are experts in environmental law.

And the clean up is getting cleverer as we hit the 21st century. Until recently the remediation of a plot of land meant little more than scooping out the dirty stuff and putting it elsewhere in landfill sites. We merrily moved the problem from one site to another. But now the Northwest is developing some considerable expertise in bioremediation - the use of micro-organisms and fungi to clean up land without simply dumping the contaminants elsewhere.

The joint research group, Brownfield Remediation to Forestry, is a case in point. It is leading the way with a number of bio-remediation projects in the region that over the past five years have led to investment of £30m in brownfield cleanups.

The group includes academics from Liverpool University and Liverpool John Moores University who have teamed up with Warrington Borough Council and the Mersey Forest (England's largest community forest) to work on the reclamation of landfill sites, sediment-stuffed canals and even contaminated mines.

The largest of these projects is in the Mersey Forest itself, where two initial phases of research and five years of experimental fieldwork have been recently completed. Stretching across 50 experimental plots at 18 sites, the bioremediation project will be monitored for 15 years and takes in a number of old-style sanitary landfills for which innovative approaches to remediation have been developed.

Phase one saw each site planted with 21 native and non-native trees and shrubs. The project teams selected the most effective species for community woodland that would not need any soil amendment or treatment and, as a result, proved that community woodlands could be created at virtually all the contaminated sites without importing new soils.

The second phase of the project addressed the issue of soil contamination, a frequent constraint to the safe redevelopment of brownfield land. Researchers investigated the feasibility of phytoremediation (the use of plants to remediate contaminated land) using short rotation coppice.

Using plants as part of the clean up does pay off. While there are no simple chemical treatments that can remove heavy metals from soil, research has shown that planting fast-growing trees like willows and poplars can markedly enhance the natural degradation of many pollutants. Nasties like petroleum residues, oils, industrial solvents, paint residues and even explosives like TNT are shown to break down more quickly, leaving the soil cleaner and safer.

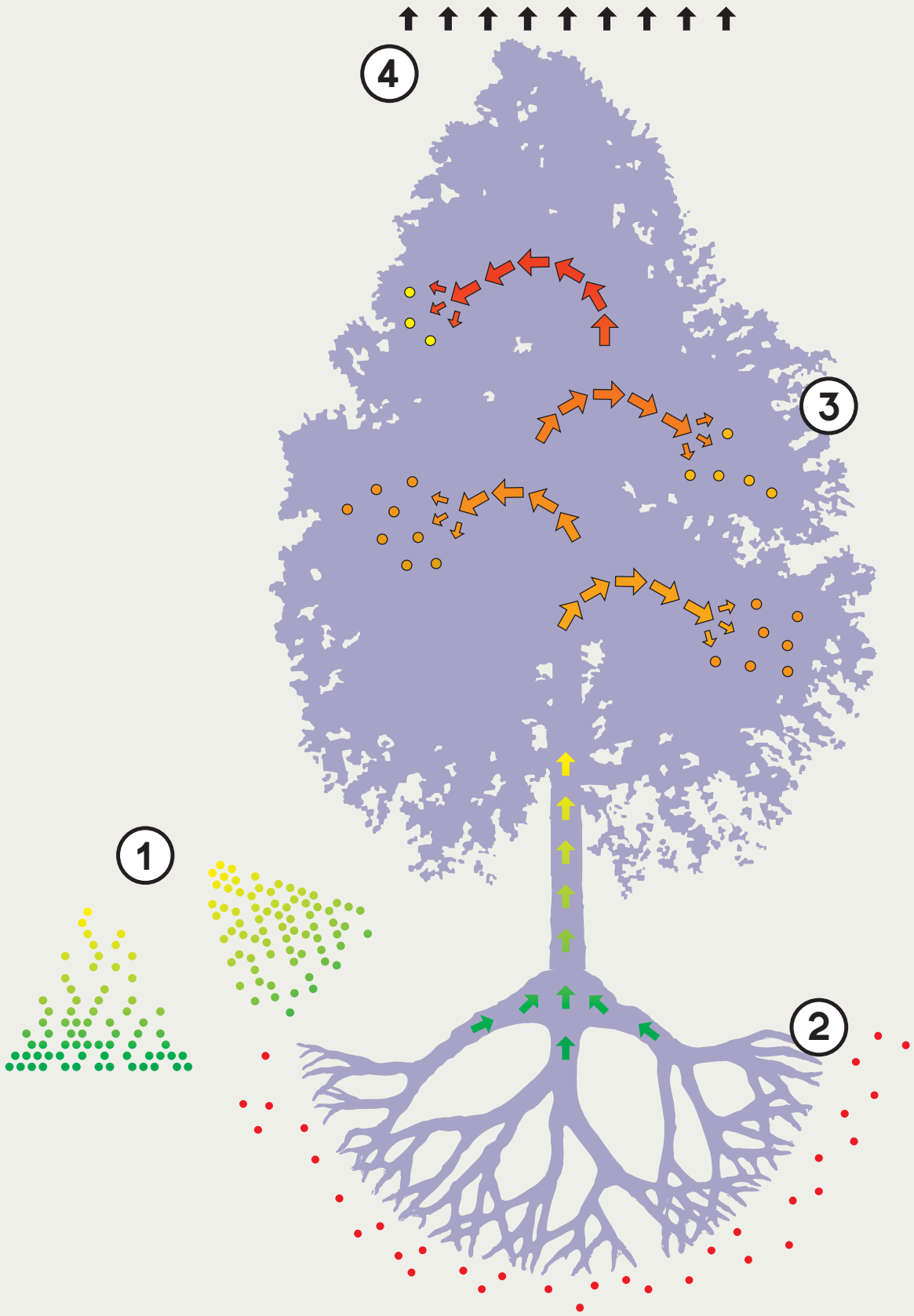
And the trees then removed from the site can be used for biomass, composite wood products or basket-making. If the trees are burned for fuel, the heavy metals do not volatilise into the atmosphere, but remain in the ash from which they can be chemically extracted. It's a real win-win, with land cleaned up and some renewable energy generated.

According to Nicholas Dickinson, professor of environmental biology at Liverpool John Moores University, the practical application of phytoremediation is not in doubt even though proven, convincing demonstrations of the technique are thin on the ground. "One problem is that the best type of plants for phytoremediation, so-called hyperaccumulator plants, are generally small, herbaceous or shrubby plants with a low yield," says Dickinson.

"In the best known example, Indian Mustard was grown in lead-contaminated soil at a Magic Marker factory in the US with a chelate also added to the soil.

"Another more recent and convincing example is the use of a fern - Pteris vittata - to remove arsenic from ground contaminated with wood preservatives. This is in the early stages of demonstration.

"Now, in Liverpool and elsewhere we are growing short-rotation coppice trees, especially willows, to do the job. Yields are very high and they hold particular promise for some contaminants, especially cadmium." As well as being harvested for biomass energy, the trees also improve the aesthetics of brownfield land.



PHYTOREMEDIATION EXPLAINED

(1) Heavy industry has left us with a number of pollutants in our soils, including heavy metals, petroleum residues, industrial solvents and even explosives like TNT. Where contaminated soils are traditionally scooped out and landfilled, phytoremediation offers a more sustainable alternative.

(2) Phytoremediation is the use of plants to remediate contaminated land. Fast growing trees like willows and poplars can be used, as can 'hyperaccumulator' plants such as small, herbaceous shrubs.

(3) The growing plants absorb or help to assist in the natural degradation of many pollutants. One study in Liverpool showed particularly high yields for cadmium.

(4) After the remediation is complete the trees are removed from the site and can be used for biomass, composite wood products or basket making. If the trees are burned for fuel, the heavy metals do not volatilise into the atmosphere, but remain in the ash from which they can be chemically extracted.

The Liverpool trial has been running for four years and will take at least ten years before there's some truly convincing evidence to show that willow works, but Dickinson is confident. "The combination of high yield and rates of cadmium accumulation that realistically can be achieved suggest this is a viable technology," he says. And though it may be slow, it's a cheap technology, costing as little as one per cent of the cost of a landfill-based solution according to Dickinson.

The private sector is also beginning to develop expertise in other innovative forms of remediation. One such is Mineral Solutions, formed in 1996 to link the academic excellence and innovation potential of mineral science-based research communities at the universities of Manchester and Newcastle with the needs of the petroleum, nuclear, mining and environmental business sectors.

The company offers consultancy services, that include preparation and analysis of geological materials and determining the mineralogy or chemical composition of materials such as waste samples and platinumdrill cores.

Mineral Solutions' latest research is focused on in situ immobilisation of pollutants. With the aid of a SMART award, it is developing an in situ bioremediation technology that aims to stimulate the biomineralisation of contaminated land. The proposed technology will, as a result of this biomineralisation, produce a subsurface, reactive barrier that will degrade and immobilise any pollutants in the soil.

Stephen Woods, general manager, predicts that the technology, jointly developed with the University of Manchester Department of Earth Sciences, the University of Manchester Environment Centre and the Manchester Science Enterprise Centre, will offer an effective alternative to traditional technology currently employed by remedial operators.

He says: "The technology capitalises on natural processes, on the bacteria that live in the subsurface. Our approach has the potential to physically impede contaminants in the subsurface, with the added benefit that the bacteria we are aiming to stimulate can also degrade a broad range of toxic organics, while immobilising problematic metals and radionuclides in the reactive barrier."

Similar innovations are being developed elsewhere in the region. Shell Global Solutions has a joint project with the Environment Agency called the SIReN project - Site for Innovative Research in Natural Attenuation - based at an unidentified site in the Northwest.

There are several research projects taking place at the site, including 'monitored natural attenuation'. This is effectively natural bioremediation, letting nature 'do her thing' and get to work on the cleaning up process. Without the need for an engineered, man-made intervention many of the biodegradable contaminants at a site are actually degraded by the naturally occurring, indigenous microbes - properly managed, the site cleans itself up. True, it tends to be slower than engineered bioremediation but can be achieved at lower cost, because it is done in situ and the only costs are those of monitoring and perhaps some predictive modelling.

Gordon Lethbridge, who leads the project for the Northwest-based company, says: "Shell Global Solutions also do a lot of in-house research into bioremediation of petroleum contaminated sites." Lethbridge lists a range of technologies being developed both on and off-site that would tax the most technical of readers: "We are evaluating both ex-situ - landfarming, composting and biopiling - and in situ approaches, such as bioventing, biosparging and bioslurping. Many of our field trials are based all around the world."

While the 'bioslurping' revolution may be almost with us, there are still some conventional landfill techniques being used, and while this approach is still being employed, Northwest researchers are developing solutions that make the best of a bad job through engines that can run on the methane produced by landfill sites. Westlakes Scientific Consulting (WSC), based in the Lake District, has been advising them.

Steve Bradley, general manager, outlines the issues facing them and how Westlakes was able to help. "What are the exhaust emissions from these installations? Where on the site should you locate the gas engine to minimise impact on neighbours?

"WSC uses sophisticated computer models to predict the concentrations of exhaust gases around proposed sites. With our models it is possible to look at all scenarios and to choose the site and operating conditions so that impacts are minimised."

Of course, the best way to deal with contaminated land is not to contaminate it in the first place. A suite of software products close to completion at the University of Manchester aims to provide a new standard for analysis of waste minimisation and resource flows on a regional scale.

The software, Eco-Region, will assess production and consumption on a regional level to inform strategic waste management and reduce waste disposal to landfill. Developed by the University's Centre for Urban and Regional Ecology in conjunction with the Stockholm Environment Institute (York) and Sustainability Northwest, the software will then be able to provide a benchmarking and reporting system for waste minimisation and resource productivity in sectors, firms and products.

IF THE TREES ARE BURNED FOR FUEL, THE HEAVY METALS DO NOT VOLATISE INTO THE ATMOSPHERE, BUT REMAIN IN THE ASH FROM WHICH THEY CAN BE CHEMICALLY EXTRACTED. IT'S A REAL WIN-WIN, WITH LAND CLEANED UP AND SOME RENEWABLE ENERGY BEING GENERATED

Joe Ravetz, deputy director of the Centre for Urban and Regional Ecology, describes the software as "a crystal ball to design the future region people want to live in".

From modelling, to 'biosparging' and willows that love cadmium, work such as this is particularly vital because the Northwest will run out of landfill capacity in five or six years. The bioremediators and researchers pioneering plant-based decontamination technologies are helping hit a number of Northwest targets including land reclamation, waste minimisation, recycling and energy recovery. They are also developing a viable and marketable new industry.

Mark Atherton, head of sustainability for the Northwest Development Agency underlined the importance of the bioremediation industry. "Regenerating the Northwest means doing things differently and better than we have before - we can't simply move pollutants from one site to another or pass the buck, we really need a comprehensive clean up that leaves a safer, greener and more attractive environment for the future."

IN ENGLAND'S NORTHWEST WE KNOW A THING OR TWO ABOUT NUCLEAR ENERGY. IT WAS HERE THAT WE FIRST SPLIT THE ATOM AND HERE THAT BRITISH NUCLEAR FUELS (BNFL) ESTABLISHED THEIR HEADQUARTERS BEFORE GOING ON TO ACQUIRE AN IMPRESSIVE 12 PER CENT SHARE OF THE GLOBAL NUCLEAR MARKET. NOW AS THE TREND MOVES FROM NEW POWER STATIONS TO DEVELOPING A PROGRAMME OF DECOMMISSIONING, THE NEWS THAT THE NUCLEAR DECOMMISSIONING AUTHORITY IS TO BE BASED IN THE NORTHWEST THROWS UP A NEW SET OF OPPORTUNITIES AND CHALLENGES.

WORDS BY **AMANDA WOOD**

NUKE KNOW-HOW

England's Northwest was where it all began and where it will begin to end. Nuclear fission is out of fashion and the new nuclear industry is all about cleaning up and closing down the venues after nearly 60 years of atom-splitting. Get ready for the Nuclear Decommissioning Authority, the Mr Muscle of the nuclear age with the power to get rid of those irritating (or should that be 'irradiating'?) stains.

The DTI's decision to site the Nuclear Decommissioning Authority (NDA) in West Cumbria,where the cream of our nuclear-savvy crop resides, is a real coup for the region and one which the Northwest Development Agency worked hard to achieve, beating off competition from eight other regions in the UK to secure the first dedicated decommissioning body in Europe.

Set to start operations from April 2005, the new body will take over BNFL's and UKAEA's task of cleaning up the country's nuclear liabilities (that's radioactive waste and ageing reactors to you and me), and in so doing offer a genuine opportunity for the region to become a global leader in the clean-up and decommissioning of civil nuclear sites.

And it will be quite a task. During the forties, fifties and sixties, the UK's civil nuclear programme paid scant attention to decommissioning in what was a period of rapid technological advancement. Fission was achieved for the first time in 1945, and by 1953 we had fully operational reactors, so the basic assumption was that science would find a way to deal with the by-products of this new source of energy.

Like all assumptions, this proved to be only partly true, and more recent installations, like Thorp, were created with decommissioning in mind. 'Legacy installations' - or the ones that weren't designed in this later way - present a more complicated proposition for the NDA, which will face the task of auditing these establishments before they can begin to deal with whatever may be stored there.

The task of decommissioning our nuclear legacy now lies ahead.

Nuclear waste constitutes only about one per cent of the UK's total waste - or about 40,000 cubic metres annually. Low-level waste can be disposed of with relative ease at surface disposal sites, but a management strategy has yet to be provided for intermediate and high level waste, much of which still resides at the site where it was generated.

The NDA, therefore, has a task that will see £48bn spent on clean up during the next 100 years or so, £10bn of which will be invested over the next ten years as the chore of addressing our nuclear legacy begins.

This corralling of all civil nuclear liabilities under one authority is part of the government's plan to ensure the task is done with 'openness, honesty and transparency' and in such a way as to inspire public confidence. BNFL's head of commercial marketing, Paul Miskimin, believes the decision to form the NDA is "brilliant" and one which will see taxpayers' money better spent.

"The government's approach is inspired and putting the NDA near Sellafield, which will represent around 60 per cent of future clean up activity, is perfectly appropriate and good news for the area," he said.

Operating as a national programme manager for clean up, the NDA will initially employ around 100 staff across business management functions and use sub-contractors for clean up and decommissioning activity. It is estimated that 19,000 graduates and skilled workers will be needed by the NDA over the next 15 years and if the Northwest is to take advantage of this opportunity, we would be wise to ensure those skills exist within the region.

Engineering abilities will be much in demand, and with the UK turning out about 10,000 qualified engineers each year, when it needs around 35,000 to simply keep moving (or not if Network Rail's infrastructure upgrade is anything to go by), some of the decommissioning activity in the future may be subbed to foreign contractors.

Dr Steve Bradley, general manager of Cumbria's Westlakes Research Institute (WRI), believes that getting the skills balance right will be the key to the success of the NDA. The WRI operates as a charity developing higher education in healthcare and environmental sciences and acts as a scientific consultant to the nuclear industry the proceeds from which are ploughed back into the charity. He believes that the money the NDA will have £10bn over the next ten years could fly out of the region if the skills aren't here.

"The NDA has to select the best available skills owing to the nature of the work and the stringent safety requirements, that means that the best trained will be well-placed to profit from the activity," he said.

AS PART OF THEIR PREPARATION for the arrival of the NDA, Westlakes has set up a Nuclear Skills Academy, a partnership between related organisations which will look at the range of necessary skills for the future.

"Decommissioning is going to be a significant industry but training people in the skills needed to close something down, rather than those needed to create something, must be supported with a clear demonstration that there is a career path and extensiveopportunities," he said.

Currently, the best placed organisations to deal with decommissioning are those who are already doing it, and BNFL has secured a ten-year contract to manage UK sites, after which the work will go out to tender.

And in the midst of dealing with the UK's nuclear legacy and the majority of the UK's nuclear installations are now either nearing the end of their active life or are in the process of being decommissioned - there still hangs the question of what we do next. By 2020 fossil fuel options will be limited, mankind is still at least 50 years away from achieving the Holy Grail of nuclear energy generation fusion, and projections are uncertain on the level of renewable energy generation we will have in place. So is the building of new reactors an inevitability? The government hasn't ruled out new reactors but seems to be looking to existing energy efficiency measures and innovation in areas such as renewables to come up with results before it commits itself.

Whatever the future energy mix, the task of decommissioning the legacy of our nuclear past lies ahead of us and looks set to deliver some fresh opportunities and challenges for England's Northwest.

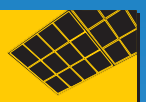
THE EARTH IS GETTING WARMER AND A GOOD PART OF THE BLAME HAS BEEN PINNED ON HUMANKIND. BY BURNING FOSSIL FUELS AND STEADFASTLY REFUSING TO USE ENERGY MORE EFFICIENTLY, WE ARE RELEASING CARBON INTO THE ATMOSPHERE AND GIVING A SERIOUS BOOST TO THE 'GREENHOUSE EFFECT'. IT'S TIME FOR TECHNOLOGY TO DELIVER THE LOW CARBON SOLUTIONS WE NEED TO GET OUR ENERGY USE - AND OUR CLIMATE - UNDER CONTROL.

WORDS BY **ERIKKA ASKELAND**

If we want to live in a world where we assume the energy is going to be there whenever we flick a switch, then we must take responsibility for how that energy is produced.

CRUNCH TIME FOR CARBON

Solution: solar power + photovoltaics have the potential to supply 10,000 times more energy than the world currently uses.

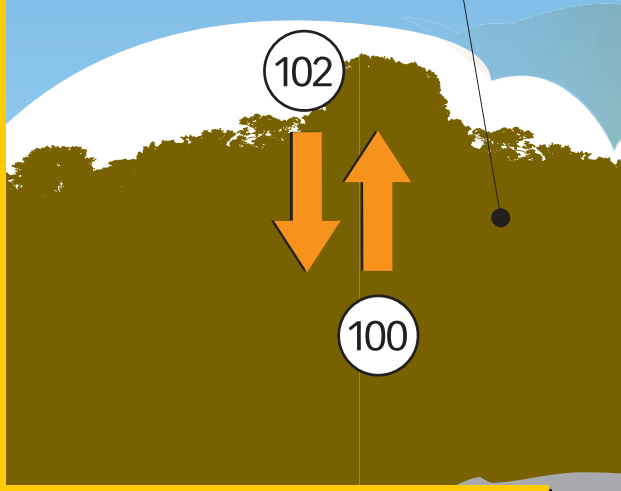


Challenges: as temperatures grow by up to five degrees, the challenge will be for industries like manufacturing, construction and chemicals to adapt.

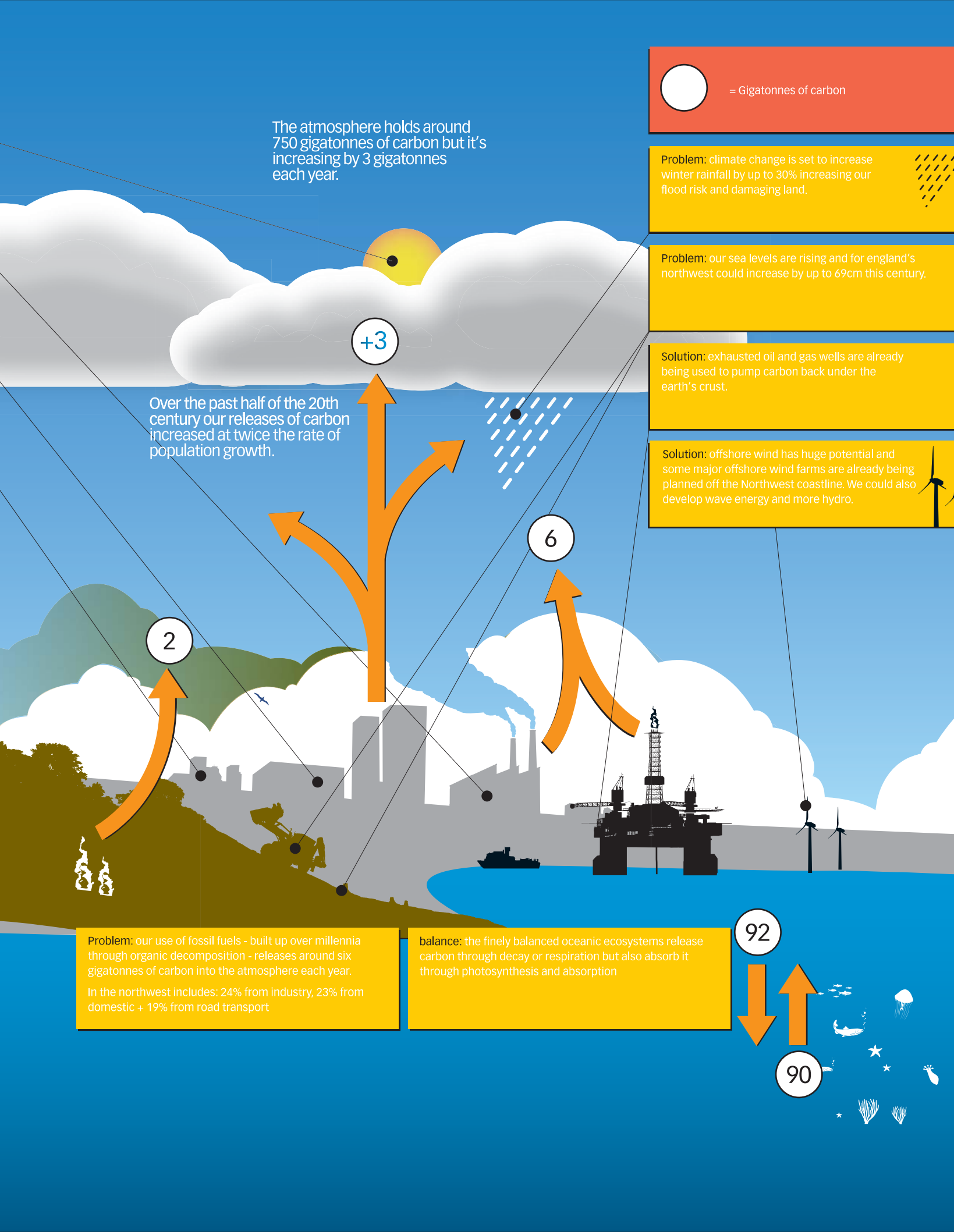
Solution: from low energy lighting to hi-tech fuel cells and hybrid cars, we can use energy more efficiently.

Problem: increasing temperatures will damage our natural environmental habitats and increase the number of pests.

Solutions: we could use biofuels like wood to supply more carbon-free energy and could plant more forests to sequester carbon.



Balance: photosynthesis, respiration and decomposition move around 100 gigatonnes of carbon in and out of the atmosphere each year. the burning and clearance of forests releases around two gigatonnes.


= Gigatonnes of carbon
The atmosphere holds around 750 gigatonnes of carbon but it's increasing by 3 gigatonnes each year.
Problem: climate change is set to increase winter rainfall by up to 30% increasing our flood risk and damaging land.
Problem: our sea levels are rising and for england's northwest could increase by up to 69cm this century.
+3
Solution: exhausted oil and gas wells are already being used to pump carbon back under the earth's crust.
Over the past half of the 20th century our releases of carbon increased at twice the rate of population growth.
Solution: offshore wind has huge potential and some major offshore wind farms are already being planned off the Northwest coastline. We could also develop wave energy and more hydro.
6
2
Problem: our use of fossil fuels - built up over millennia through organic decomposition - releases around six gigatonnes of carbon into the atmosphere each year.
In the northwest includes: 24% from industry, 23% from domestic + 19% from road transport
balance: the finely balanced oceanic ecosystems release carbon through decay or respiration but also absorb it through photosynthesis and absorption
92
90

Thousands of jobs could be generated in the UK, not only serving our own energy requirements, but also exporting our skills

Climate change. It's here. The world's glaciers are receding, the Arctic ice pack has lost about 40 per cent of its thickness over the past four decades, and the global sea level has risen about three times faster over the past 100 years than over the previous 3,000. In England, the 1990s experienced four out of the five warmest years on record, with 1999 being the joint warmest year ever recorded.

According to the UK Climate Impacts Programme (UKCIP), temperatures in the Northwest could rise by an average three degrees Celsius or higher as early as 2050. Those depressed by dreary rain in Liverpool, Carlisle and Manchester might be cheered to find that summer rainfall could be reduced by 60 per cent in areas of the Northwest by 2080. However, the pleasures of dryer, warmer summers would be marred by winter precipitation, which, by the same scenario, is likely to increase by 30 per cent. Instead of the Northwest becoming the new Med, we'd be more likely to suffer hot, uncomfortable summers threatening drought, and sodden, even more miserable winters likely to cause flooding.

The most troubling aspect of the UKCIP study is that sea levels, in a region which can boast more than 80km of coastline, could rise by anything from 7cm to 36cm by 2050, and by as much as 9cm to 69cm by 2080, putting some of the region's key coastal towns and cities, such as Liverpool, Blackpool and Barrow at risk.

All may not be lost. There are a host of possible solutions to the carbon crisis, many of which are being developed in the Northwest. Renewable energy, such as that produced from wind farms, wave and tidal power, and photovoltaic (PV) cells are being researched and developed in the region, and a recent study by Renewables Northwest estimates that they could soon produce over ten per cent of the region's energy demands.

Good, but not good enough perhaps.

A different study by Enviros and the University of Manchester Institute of Science and Technology (UMIST) says that the region will still fall far short of targets established both at Kyoto and by government.

Clearly more has to be done. "Somehow or other we have got to take responsibility for the way in which we produce electricity," says Julian Carter, general manager of Renewables Northwest. "If we want to live in a world where we assume the energy is going to be there whenever we flick a switch, then we must take responsibility for how that energy is produced. And we don't.

"Right now, the way that power is being produced is causing damage to the environment. It is our collective obligation to understand there are alternatives which can sustain the way we want to live."

Those alternatives can, quite literally, be rubbish. There are several projects in the region which harness methane produced by decomposing waste to create energy. Emissions are collected at landfill sites and are used to spark an ignition engine powering an electricity generator. Major landfill gas sites are being operated right across the region - from Wirral (Bidston Moss) to Warrington (Arpley and Risley) and from Lancaster (Salt Ayre) to Wigan (Highmoor Quarry and Greenside Way).

There's more power from waste on the Wirral courtesy of an exciting new project using an experimental bioreactor at Warren's Nursery in Thingwall. It has been used to produce electricity via a generator powered by gas collected from decomposing organic waste.

The bioreactor is not unlike a greenhouse with five underground digestion cells, each capable of holding up to 100 tonnes of waste including vegetable and fruit peelings. Surplus electricity can be transported to the National Grid.

The project is a pilot initiative operated by a partnership between AMEC, the University of Liverpool, Wirral Council and Groundwork Wirral, and provides an alternative to dumping compost on landfill sites. The project, initiated in 2001, was the first of its kind in the country and has attracted the attention of scientists and environmentalists from Poland, Hungary and China. If the project becomes widespread, it could also help offset the cost of waste disposal in agriculture, which is estimated to cost the UK £3bn a year.

The most significant source of renewable energy in the Northwest is wind power. As the UK is considered to be the windiest country in Europe, and a commitment that ten per cent of electricity in the UK should be generated from renewable sources by 2010, the future for offshore wind looks promising. Following a recent government announcement to develop further offshore wind farms in three areas of the UK including the Northwest, the region now has the potential to produce 375m megawatt hours (mwh) per year, the equivalent of ten per cent of the Northwest's required energy.

In the government's first round of offshore projects, which opened for tender in 2000, projects off the Northwest's coastline ranged from the Solway Firth to North Hoyle in Wales, with collective potential to generate enough electricity to power 600,000 homes. Four projects are expected to come on-stream next year, while four projects outside of Southport are currently at the planning consent stage.

If all the currently-planned offshore schemes in the Northwest get the go-ahead, Carter estimates that it will bring £850m to £900m investment into the region, and the DTI also estimates that the phase two offshore wind projects could create up to 30,000 jobs in the region.

"The consequences will be, one, an even better environment, and two, an enormous business opportunity," says Carter. "It is a second industrial revolution - an environmental, industrial revolution. Thousands of jobs could be generated in the UK, not only serving our own energy requirements, but also exporting our skills. It is such an enormous business opportunity."

One of the main criticisms lobbied against wind power is that the wind doesn't blow all the time but this is where projects such as a potential biomass generator in Cheshire and other sources of renewable energy such as photovoltaics (PV) fill in the gaps. The Co-operative Insurance Society has proposed to clad its tower - the tallest in Manchester - with PV. If they are able to accomplish this, others are likely to follow suit, which should have the knock-on effect of making PV more affordable.

Marine power is an option too. There is research being undertaken at the University of Lancaster's Department of Engineering into capturing the power of waves and tides. Researchers there are working on two solutions - one device designed to sit in relatively shallow waters called the Frond, and a larger, deepwater device, the size of a tanker ship, called the PS Frog.

"Of course, there is a bit of a caveat with any renewable energy, be it wind, wave or whatever, in that it doesn't happen all the time. It's not 100 per cent reliable," says University of Lancaster wave energy researcher Martin Widden. "On the other hand, in winter when you need it, generally speaking, waves are pretty reliable."

Other technologies employed to capture the power of waves have been developed by Bendalls Engineering, a metal fabricator based in Cumbria. Recently, Bendalls worked with a number of other partners to develop a marine current turbine, an exciting new sub-surface propulsion unit powered by water currents giving a consistent, quiet and unobtrusive 300kw energy supply. The first prototype has been tested 3km out to sea close to Lynmouth, north Devon.

The prototype has been developed with a single turbine. As maintenance of the device underwater would be both difficult and expensive, the assembly containing the rotor, gearbox and generator can be moved up the pile to allow access above the sea's surface. If the trial is successful, there are plans to develop the concept further by adding another turbine to create a MW-scale unit. This may be followed by construction of up to seven of these units for grid connection in late 2006.

In the growing field of renewable energy, Widden admits that there is a healthy, if friendly, amount of competition between people developing different sources of renewable energy.

"The wind people have got a start on us. There's a lot of commercial wind turbine manufacturers now they are getting to a stage of pretty good development. They are reliable and effective at capturing power from the wind when it blows, but it isn't all the time."

New energy solutions may be coming on-line but many still argue that we simply aren't advanced enough to cut our carbon in time to get our climate back under control.

Perhaps one of the more startling solutions proposed is carbon sequestration. There are a number of ways of 'sequestering' existing carbon from the environment, one is to create 'carbon sinks' by planting CO_2 absorbent forests, which is favoured by many countries such as the US and Canada. However, this form of sequestration is not terribly efficient and if the UK were to double its forests (an unlikely scenario), it would still only be able to absorb two to four per cent of current emissions.

A more aggressive form of sequestration being considered is removing or filtering carbon emissions at source - from flue gases generated during combustion in power stations liquidising it, then pumping it somewhere underground or under the deep sea.

Carbon sequestration by this method is understandably controversial. "The science can probably be made to work, but climate change arguments often aren't about the science," said Dr Simon Shackley, a researcher at the Tyndall Centre, based at UMIST.

"Governments must consider the possible public backlash before going down this track. If there's a negative response to this, we need to know now. After all, to some people it might look like we're throwing our pollution into the sea."

Pumping carbon dioxide into disused oil and gas wells has been used in the oil industry for some time to improve the recovery of oil from depleted wells, but the first attempt at large-scale injection for the sole purpose of isolating CO_2 from the atmosphere has been implemented in the Norwegian North Sea at an offshore gas plant owned by Norway's state oil company Statoil. The company strips excess CO_2 from the recovered gas in a tower on its offshore platform, injecting the captured CO_2 into the Utsira aquifer (a layer of sandstone filled with saltwater) 800 meters below the surface. Since 1996, the company has pumped up to 1m tonnes of carbon per year into the aquifer, saving them the cost of the tax levied on carbon production in Norway (£38 per tonne since 2000).

The initial success of the Statoil experiment has kick-started a number of similar projects in the US and Europe. However, it is not a universally popular way of disposing of CO_2 and numerous groups have protested against such plans, at best considering it a technological fix, at worst suggesting that it is a way to dump CO_2 in places that are untested and perhaps dangerous. Studies have shown that CO_2 leaking from an underwater aquifer, for example, could be fatal to deep sea wildlife, and there are similar fears for human populations next to land-based storage solutions.

In the Northwest there are areas under the Irish Sea believed to be suitable for carbon sequestration. Likewise it is believed that disused salt caverns in Cheshire could also be used to store CO_2. However, Shackley points out in his research that plans to store natural gas in Cheshire salt mines met fierce opposition, a scenario likely to be repeated if proposals for CO_2 storage were put forward.

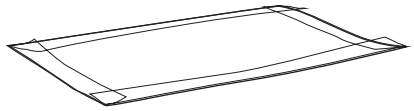
There are many who would rather see us keep our focus on renewable energy rather than sequestration. Julian Carter is sceptical about whether widespread carbon sequestration might not put off efforts to develop more sustainable methods of energy creation: "I'd be uncomfortable if carbon sequestration meant that we disincentivised ourselves from actually doing the things we need to do, which is to make more renewable power."

It is a second industrial revolution - an environmental industrial revolution

HOW TO RECYCLE YOUR COPY OF IE

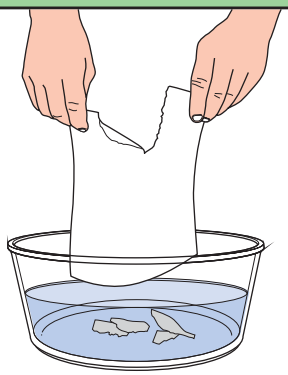
WHAT YOU NEED: Your copy of IE, Blender or whisk, Liquid starch, Shallow pan, Rolling pin

1



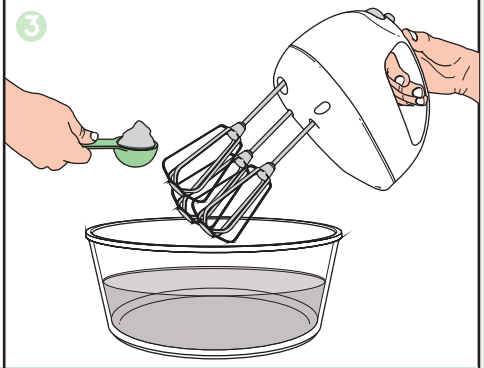
Prepare your screen by cutting out an oblong about 35cm long and 25cm deep. Fold the edges twice to make a frame. Ask an adult to help if you get stuck.

2



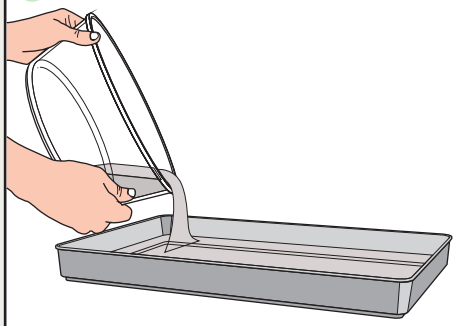
Tear up your copy of IE (after you and at least three others have read it) and place in a large bowl. Add hot water to almost the top.

3



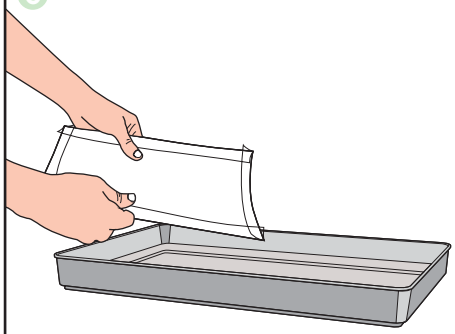
Ask an adult to whisk or blend the paper mixture. And then add a tablespoon of starch.

4



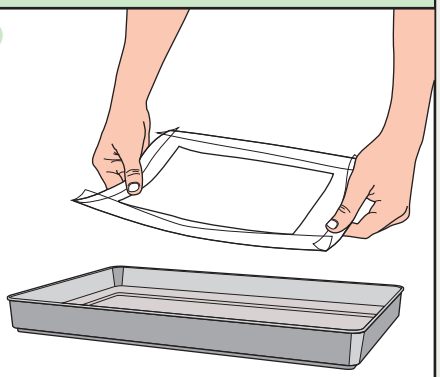
Pour the mixture into a shallow pan. Be careful not to pour any on the floor.

5



Slide the screen to the bottom of the pan and gently move it around to get an even layer of the mixture ontop of the screen.

6

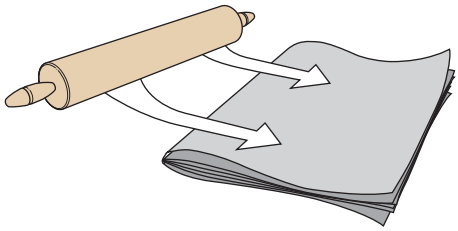


Lift the screen straight off the pan. Hold the screen over the pan so that some of the water can drain away.

7

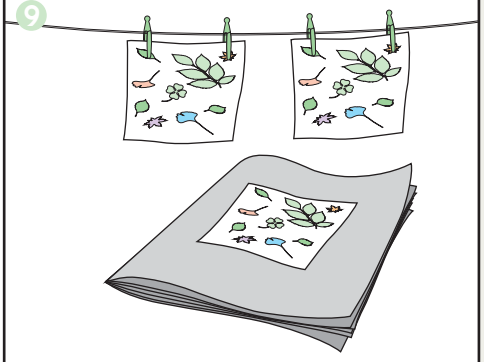
Place the screen, with the pulp side up, on a pile of newspapers. You can add flower petals, glitter or leaves to create your own special paper.

8



Cover your paper with more newspaper and roll with a rolling pin to squeeze out the water.

9



Lift off the top newspaper. Gently peel the homemade paper from the screen and allow it to dry on fresh newspaper.

RIGHT RESOURCE, WRONG PLACE

TECHNO-SOLUTIONS AND A NEW SENSE OF PURPOSE COULD CURB OUR USE OF RESOURCES AND CUT OUR POOR RECORD ON WASTE AND RECYCLING.

WORDS BY **CHRIS DESSENT**

Blue Peter had it right all along. True, they wore bad jumpers, ran endless irritating competitions and owned pets that always weed on the floor, but they knew how to recycle. Generations of kids are now able to build rockets, trains, Yule logs and pop-up cards for their grannies using little more than a toilet roll, some milk bottle tops and a strip of double-sided sticky tape. The BBC should be congratulated for a show that managed to encourage more toilet roll recycling and cereal box re-use than any local authority scheme going.

But Blue Peter alone can't solve the waste and recycling puzzle and it's time we started recycling and 'remanufacturing' for real. Devotees of recycling refer to waste as a resource in the wrong place: something to re-use, recycle or remanufacture and not stick in a non-biodegradable bag and bury in the ground. In short, waste is lost profit for business and a source of higher taxes for the rest of us.

The facts speak for themselves. According to DEFRA, waste costs British business £50 billion per annum and the Environment Agency estimates Northwest manufacturing companies alone could save over £450 million each year by minimising waste. At the current rate of waste generation, we will run out of landfill capacity in the Northwest in six years. More recycling is no longer desirable - it's critical. The government's target (seen by many as conservative) of more than tripling domestic waste recycling in ten to twelve year's time is only the start of the war on waste. Zero waste, achieved through recycling, reuse and remanufacturing is now the end game.

In the Northwest, the challenge is beginning to be met and the region's universities, entrepreneurs and market developers are pioneering the next generation of recycling solutions. And what's more they are making recycling pay.

"The most important thing is to generate demand," explains Jonathan Aylen, senior lecturer at UMIST and scrap adviser to CORUS. "If the markets are there, people will recycle, because it's profitable." According to Jonathan, many companies in the region are already making recycling work: "If you look at the Northwest, many companies are making a healthy profit. Warrington is one of the largest recycling centres in the UK and yet nobody knows about it. They are just getting on with it quietly." The market value of recyclable materials varies and one of the main challenges is to develop collection, segregation and reprocessing solutions that maximise the market return. Secondary materials markets such as textiles, can recycling and scrap steel are already thriving, and for Jonathan the next challenge is to lubricate the market mechanism and build on what is already working: "There is no question that the profits are out there."

When it comes to sustainable production, the aim is simple: to use materials in cycles, and instead of producing waste and pollution, only emit materials that can be food, fuel or raw materials to produce something else referred to as a 'closed loop'. In the Northwest, the Clean Merseyside Centre is working to develop markets for recyclable materials that are sustainable, diverse and of a high value. They provide support and technical expertise at each stage of the process from collection and segregation through to reprocessing and manufacture. Their work with Jaguar is a recent example of how effective they can be as manager Dr Helen de Lemos explains:
"Our work with Jaguar Cars has resulted in waste plastics from the production line being collected and used by a local reprocessor to manufacture street furniture, bollards and fencing on a commercial scale."

The CMC is also pioneering research on the use of glass in pre-cast concrete blocks, the use of green waste compost for landscaping, and has recently demonstrated the benefits of replacing sand with granulated glass in golf course bunkers. At last, as Helen explains, the UK recycling industry is emerging, the technologies are available and it is now time to invest and support the industry. "We have enormous potential and a high density of material reprocessors. The Northwest Development Agency has recognised that these industries are important to the region's economy and our universities are leading the way on innovation."

Innovation is at the heart of Sustainability Northwest's study into the feasibility of establishing a regional Remanufacturing Park. The study will consider the benefits of developing a combined materials remanufacturing facility on one site. Waste materials will be delivered to the site to be processed and converted into high value commodities for resale. By reducing transportation costs and utilising combined heat and power energy systems, the vision is to create a model of how the value of recyclable materials can be maximised. As project manager Clair Visco explains, the facility will aim to be truly sustainable: "The study will also explore opportunities for incorporating renewable energy technologies and consider a social enterprise approach to business management, plus we hope to demonstrate the benefits of including an incubator-style research and development unit on site to lead on technology enhancement and new recycling solutions."

The scale of the waste and recycling challenge should not be underestimated, but what is evident is that the Northwest is gearing up to claim its share of a recycling market that is already worth £20 billion in the UK. The snowball effect has begun. The Region's Waste Strategy is currently out for consultation and is likely to be in place early in 2004, Envirolink Northwest is embarking on a remanufacturing waste project, and a resource efficiency programme (led by ENWORKS) begins in the autumn. New partnerships are making the links between science, technological innovation and practical action on the ground.

DEVOTEES OF RECYCLING REFER TO WASTE AS A RESOURCE IN THE WRONG PLACE: SOMETHING TO REUSE, RECYCLE OR RE-MANUFACTURE AND NOT BURY IN THE GROUND.

In terms of the future, Dr Helen de Lemos at the Clean Merseyside Centre is optimistic: "Recycling is the solution. If we invest, the growth potential and the profits will be considerable." And as Jonathan Aylen at UMIST makes clear, the idea of recycling not being profitable is nonsense, the technologies might be more advanced but profiting from waste is tried and tested: "Have no doubt, the rag and bone man knew a thing or two about profiting from waste long before we woke up to the idea."

WE'VE CLEANED UP OUR RIVERS, CANALS AND COASTLINES DRAMATICALLY IN RECENT YEARS, FROM OXYGENATION IN SALFORD QUAYS TO SALMON RETURNING TO THE MERSEY ESTUARY. HOW DID TECHNOLOGY AND SCIENTIFIC MONITORING PLAY A PART?

WORDS BY **AMANDA WRIGHT**

BUBBLING UP

As late as 1985, the Mersey Estuary remained the most polluted waterway in Europe. Four years earlier, in a remark that has become part of the river's folklore, the then Secretary of State for the Environment, Michael Heseltine, described the Mersey as "an affront to the standards a civilised society should demand of its environment".

The river was receiving up to 60 per cent of mainland pollution, generated by both industry and a domestic population of more than five million. But that was about to change as 1985 also saw the establishment of a new organisation, the Mersey Basin Campaign, charged with finding ways to clean the river and its catchment.

Fast-forward almost 20 years and water quality has improved dramatically. Partly as a result of initiatives such as the Campaign, partly thanks to more stringent EU requirements, but also because of technological innovations and advances in scientific understanding. Where once they spawned the industries that left the region's rivers dead and polluted, now science and technology are helping to restore them.

The textiles, chemicals, paper and glass industries that grew out of the industrial revolution historically used the region's waterways as a convenient conduit down which to flush their industrial waste. The result was a legacy of pollutants that includes noxious substances ranging from mercury to DDT, as well as persistent organic contaminants such as polychlorinated biphenyls (PCBs) and pentachlorophenol (PCP). As industry grew, so did the human population and their domestic waste was disposed of directly into the region's waterways. In the end, the environment's capacity to degrade, dilute and disperse the sheer weight of material put into it was simply overwhelmed.

In 1981 North West Water, the water utility at the time, embarked upon a clean-up scheme designed to counteract the years of misuse and neglect. One of the first steps was to tackle direct discharges of crude sewage into the regions waterways. Such discharges helped rob the water of oxygen, creating a major stumbling block to bringing the rivers back to life.

For example, as part of the Mersey Estuary Pollution Alleviation Scheme, a new primary sewage works at Sandon Dock near Liverpool replaced 28 crude sewage discharges that fed directly into the Mersey Estuary. The treatment technology itself was well-established, but it was beginning to be applied on a wider and more intensive scale.

Sandon Dock is just one programme initiated as a direct result of massive investment by North West Water (and its successor United Utilities). From privatisation in 1989 to 2010, about £4 billion will have been spent, including tertiary treatment for the removal of ammonia from wastewater - exposure to even short periods of ammonia may kill fish such as salmon. For example, at Davyhulme wastewater treatment works in Greater Manchester, a natural purification process using a biological, aerated flooded filter process removes ammonia and reduces discharges into the Manchester Ship Canal.

At the eastern end of the canal, Salford Quays, Trafford Wharf and Pomona Docks form the largest area of inland harbour in the UK. Only a few years ago the water in Salford Quays was devoid of almost all life. Small wonder then that the sight of triathletes swimming safely in the Quays during the successful 2002 Commonwealth Games was hailed as something of a triumph in terms of water quality improvement.

What made the event possible was an innovative and far-sighted management strategy involving isolation of the Quays basins from the polluted waters of the Manchester Ship Canal and installation of a compressed air mixing system. Dr Keith Hendry, managing director of APEM Ltd, the specialist aquatic science consultants responsible for the scheme, said: "The Quays basins are now managed like giant fish tanks. We alter the amount of mixing to maintain the required level of oxygen and actively manage the fish community, water plants and insect life, introducing artificial habitats for spawning, and predator evasion."

In addition, APEM have also turned its attention to the polluted water adjacent to the Quays in the upper reaches of the Manchester Ship Canal. An intensive programme of research, undertaken over a 15-year period, pointed to an absence of oxygen in the deep, lower water levels of the canal. The low oxygen levels were caused by a combination of pollution in both the sediment and water column, which literally sucks the oxygen out of the water. The solution was to vapourise liquid oxygen and inject it directly into the canal through five purpose-designed, pressurised injection units, capable of injecting up to 14 tonnes of oxygen a day at high speed into a 2km stretch of the canal. Along with United Utilities, the Mersey Basin Campaign and the Environment Agency, APEM has developed the system into a unique fully operational water management system, literally breathing new life into the once stagnant Ship Canal waters.

Regulatory measures have also played a key role in the aquatic clean up. Industrial processes that have the greatest potential to pollute are regulated through Integrated Pollution Prevention Control (IPPC), which was adopted in 1996. Processes must use the best available techniques not entailing excessive costs to prevent releases of harmful substances, a requirement that has encouraged industries to apply pollution prevention measures at source.

Regular monitoring by the Environment Agency has improved our understanding of the complexity of many of the pollution problems. Chemical and biological indicators are currently monitored as measures of river quality. But with the new EU Water Framework Directive, ecological indicators will also be monitored, leading to a much wider understanding of the processes within our aquatic systems.

There is still a long way to go. Whilst many of the highly dangerous pollutants such as mercury and DDT are decreasing within the waters of the Northwest, there are new challenges ahead. New contaminants are finding their way into the watercourses such as the suite of chemicals acting as endocrine disruptors, which can lead to sex reversal in many fish species. We need to understand the implications and long-term impacts of these chemicals on our aquatic environments, as well as identifying the technology for removing these from the system. The need for more research, new technologies and better science is far from over if we are to continue protecting and restoring our rivers.

WHERE ONCE THEY SPAWNED THE INDUSTRIES THAT LEFT THE REGION' S RIVERS DEAD AND POLLUTED, NOW SCIENCE AND TECHNOLOGY ARE HELPING TO RESTORE THEM.