

# THE FUTURE OF ENERGY

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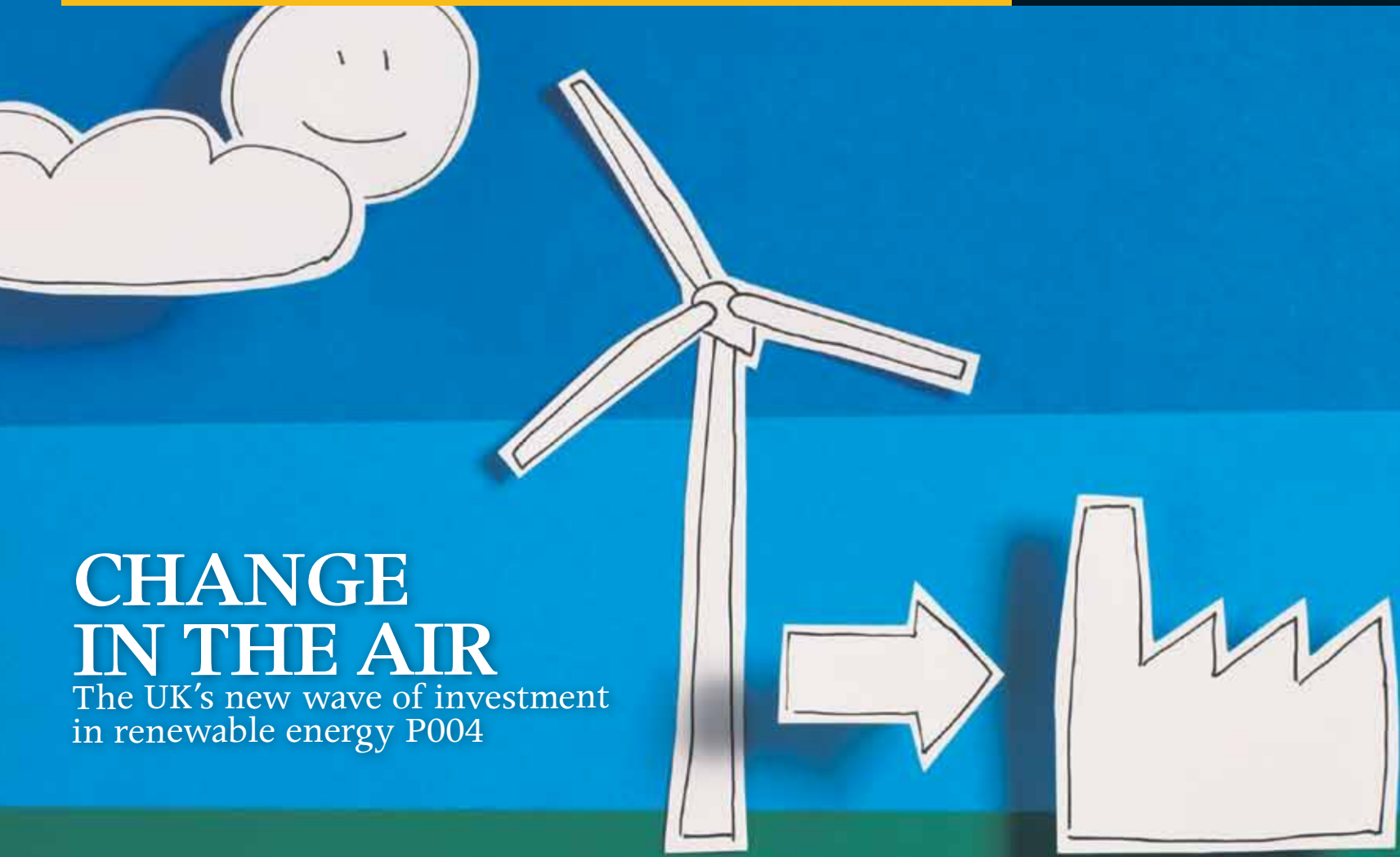
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# “We must go further and faster on climate change targets”



Huhne, the UK's Secretary of State for Energy & Climate Change, has said, 'We must go further and faster to turn climate change targets into real action. Energy investors need certainty to make investment decisions. A meaningful carbon price would drive the deployment of clean energy technology and help secure energy supplies. Getting a global deal on climate change, pushing for a 30% cut in EU emissions and the introduction of a carbon floor price in the UK are all part of that.'

EFEE, held in association with Masdar and supported by UK Trade and Investment, is Europe's premier thought leadership conference, designed for all with a serious interest in our energy future, including key industry leaders, governments, politicians, engineers, innovators, architects, lobbyists and journalists.

The forum will open with keynote presentations from international leaders including Dr. Sultan Al Jaber, CEO, Masdar, Christine Lins, Secretary-General, EREC (European Renewable Energy Council), Chris Huhne, Secretary of State for Energy and Climate Change, UK, Lykke Friis, Minister for Climate and Energy, Denmark, Pedro Marin, Secretary of State for Energy, Spain, and Carlos Zorrinho, Vice Minister for Energy and Innovation, Portugal.

The cutting edge debate on these issues, will be chaired by Steve Sedgwick, CNBC Anchor, who will put the critical questions to panellists including Kumi Naidoo, Executive Director, Greenpeace International, Thomas

Dalsgaard, Vice President, DONG Energy, Gilles Vermot-Desroches, Sustainable Development Senior VP, Schneider Electric, Matthew Chinn, Managing Director Energy Sector, UK and North West Europe, Siemens, Michael Lewis, Renewables Managing Director, E.ON Climate & Renewables, Peter Gutman, Global Head of Renewable Energy, Standard Chartered Bank, Rob Hastings, Director of Marine Estate, The Crown Estate and David Nussbaum, CEO, WWF-UK.

The conference and international exhibition will include specific streams and features dedicated to Infrastructure, Finance, Renewables and Alternatives, Clean Transport and Green Cities.

Full details and passes to attend are still available online at [www.EuropeanFutureEnergyForum.com](http://www.EuropeanFutureEnergyForum.com)

Registration for the exhibition and fringe programme of events is free of charge. We very much look forward to seeing you there.

**Jo Tyler**  
Event Director  
European Future Energy Forum



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**W**here is the money coming from to fund the new energy revolution? What kind of regulatory environment is truly commercially relevant? How can government and industry work together to develop the low carbon energy supply we need? In this report published in association with The European Future Energy Forum (EFEE), at ExCeL London, on 19-21 October, we consider the critical issues, with commentary from some of the key personalities.

And as the European nations deliver their action plans for renewable energy and carbon reduction, we explore why there has never been a more critical time for global co-operation between investors, business, and policymakers in striving to secure solutions to the world's energy needs.

EFEE keynote speaker, Chris



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## ENERGY INFRASTRUCTURE &gt;&gt;

# Change is in the air

The UK has so far been slow in building its renewable energy supply. But new sources of investment could quickly change the landscape

By Paul Gosling

**F**ossil fuel dependence is a vice that we have to be rid of. And the United Kingdom should be well positioned to be at the forefront of the energy revolution. After all, we have a natural environment readily suited to the generation of renewable energy.

Wind, wave, tidal and hydro resources are plentiful. There are also excellent opportunities to increase the provision of solar, geothermal and biomass based energy systems. Yet the UK generates a mere 3 per cent of its energy from renewable sources – a long way short of the government's target of 15 per cent by 2020.

For that to be achieved we must experience a vast increase in investment in the provision of renewable energy capacity. That is gradually becoming visible across the countryside, with new wind turbines popping up on the hilltops and offshore, as well as a few new wave and tidal power schemes being developed around the coast. In a letter this month to new environment secretary Chris Huhne, the chairman of the Committee on Climate Change, Lord Turner, stressed not only the need for the UK to up its game, but also the benefits of doing so. Lord Turner wrote: "Investment now in a broad range of renewable technologies, but predominantly onshore and offshore wind, will directly contribute to required decarbonisation.... It could also provide economic opportunities for UK-based firms."

## NEW MONEY

Alina Bakhareva, research manager for renewable energy at analysts Frost & Sullivan, is confident that this change is coming. "Overall, the UK hasn't been doing that great, compared with other European countries," she says. "It looks like the government is determined to catch up, putting effort and money into renewable energy development."

Bakhareva quotes research indicating that while wind, tidal and wave are all expected to provide a growing share of electricity generation, it is offshore wind farms that have the best prospects. "Europe is a global leader [in offshore wind], but the UK has been quite slow," she explains. "We are seeing industry step out of its cradle and a



Pentland Firth, Scotland: a promising location for tidal power

**"We are seeing industry step out of its cradle and a lot of independent projects developers are showing interest"**

lot of independent projects developers are showing interest.

"Project finance was not available, except from a limited number of investors," Bakhareva explains. "Utilities were able to finance this from their balance sheets. Now we are seeing banks and other investors interested in financing offshore wind projects. We are expecting a lot more projects will be able to secure finance. That will translate into more projects being constructed."

The company that has led the way in recent years in the UK is Scottish and Southern Energy (SSE), which is the largest player in the renewable energy market. It is also – in a joint venture with RWE npower renewable – responsible for the biggest single new renewable energy project currently under construction in the UK: the Greater Gabbard offshore wind farm, situated off the Suffolk coast. By the time it begins operations in 2012, this will comprise 140 wind turbines. When all schemes currently under development are completed, SSE will have 15,000 MW of renewable

energy capacity from hydro electric, biomass and waste-to-energy projects, as well as wind farms.

A spokeswoman for the company explains: "SSE's core purpose is to provide the energy people need in a reliable and sustainable way. In 2008, following SSE's acquisition of the renewables company Airtricity, we made a statement outlining our plans in the renewables sector and confirming a massive investment in this area." By the time it is completed, that investment programme will see the group spend £2.5bn on renewable projects in the UK and Ireland.

## POWER SURGE

Tidal and wave power electricity generating schemes are also causing a lot of interest. Studies have shown that sites off the Orkney islands and Pentland Firth in Scotland are the most promising. A site in Strangford Lough in Northern Ireland has been trialing an experimental tidal powered electricity generator, which has been performing well. The Crown Estate is about to give approval for new schemes for large scale commercial development of marine energy off the north coasts of Scotland and Northern Ireland.

Smaller scale renewable schemes have just been given a boost by Chris Huhne's decision to permit local authorities to sell surplus electricity generated by renewables to the grid. The Local Government Association predicts this will create a £100m

trade that will subsidise council taxes and will see wind turbines and solar panels sprout on town halls and leisure centres, and even on council houses.

While Huhne has stressed his commitment to renewables, the government's position on nuclear power is less clear. Prior to the election, Huhne's party, the Liberal Democrats, stated they would oppose new nuclear power plants. But the programme agreed between the two parties committed both to allowing new nuclear stations to be built, providing there was no financial subsidy. Yet, without that subsidy the viability of the sector is in doubt.

At present, renewables look a more attractive investment option – and schemes are smaller and therefore both more manageable and more affordable than nuclear. Frost & Sullivan's Alina Bakhareva believes that investors will increasingly include major supermarket chains keen both to reduce overheads and improve their images.

Yet despite all the advances, the move away from fossil fuels will be neither easy nor quick. The interim technology of carbon capture and storage (CCS) will therefore be a very important stepping stone on the journey. CCS has the potential, believes the Department of Energy and Climate Change, to reduce carbon emissions from fossil fuel power stations by about 90 per cent - making a very important contribution to carbon reduction targets.



# How Do We Power The Future?



Is it by developing the next-generation solar thermal technology or by funding tomorrow's leading cleantech companies? Is it by providing market-driven incentives to reduce carbon emissions or developing carbon capture networks? Is it by nurturing future energy leaders or by developing a cleantech cluster? Actually, it is all of the above and just the start of things to come. After all, what we are creating in Abu Dhabi is a centre of excellence dedicated to renewable energy and sustainable technologies.

To find answers and partner with us, visit us at the European Future Energy Forum, Excel, London 19 - 21 October, 2010 or email [events@masdar.ae](mailto:events@masdar.ae)

[www.masdar.ae](http://www.masdar.ae)

## Coping with the tea break

The problem of spikes in demand can be reduced by more efficient management of consumption – in industry and in the home

The biggest problem the electricity supply industry has to cope with is the huge spikes in demand triggered by events such as the FA Cup Final.

At half time, the watching millions rise from the sofa and put the kettle on. And then they go to the loo, setting off electric pumps all over the water network. The entire electricity supply network has to be built to cope with peaks in demand such as this, however short. If they could be evened out, several expensive power stations could be eliminated, saving money and driving down carbon emissions. It's such a difficult and long standing problem that a whole area of engineering has grown up to address it: demand response management.

Scott Henneberry, Vice President SmartGrid Strategy at Schneider Electric, explains that several strategies have recently emerged that may finally help reduce the

problem. Some focus on supply, adding renewable power sources and making the network more intelligent so power can be sent to the right places.

But managing consumption to eliminate spikes where they occur offers the best chance of success, he believes. And as a major supplier of electrical distribution and control equipment, Schneider is well placed to help control demand.

"We are very strong with end-users such as large commercial buildings and data centres who want to reduce peaks in consumption," he says. A key new concept is the 'negawatt' – a reduction in electricity use or 'negative-megawatt' that can be sold back to the network.

"There are aggregators in the market who contract with suppliers for power, and they don't care if they deal in megawatts or



Even homeowners will soon be able to sell their 'negawatts'

**"A key new concept is the 'negawatt' – a reduction in electricity use that can be sold back to the network"**

negawatts," Henneberry says. "We empower our customers to sell negawatts."

There are many strategies that commercial and industrial users can adopt to reduce consumption to deliver negawatts back to the grid, Henneberry says. Dimming

the lights by 20 per cent will rarely attract complaints, if it's not permanent, and offices can be pre-cooled by switching the air conditioning on at 7am and switching the thermostat up later, so most of the cooling is done when power is cheaper. Elevators can be made to run slower and ornamental fountains can be switched off.

Even UK homeowners will soon be able to save money on their electricity bill by cutting back when prices are high. Earlier this year, the Government announced plans to speed up the programme to install smart meters in every home. The meters will enable suppliers to flash messages to

householders when prices are high, so they can switch lights off, turn the heating down and defer microwaving the chicken until a cheaper period.

It will be the first time consumers have been able to see how the real price of power varies, Henneberry says: "The natural volatility in the price of energy has been hidden from the consumer by the structure of the market. If customers aren't careful they could see their energy bills doubled in the next couple of years."



## CUTTING EMISSIONS &gt;&gt;

# Politics, investment and the \$316 trillion question



A windfarm in Cumbria

Meeting international CO<sub>2</sub> emissions targets will be expensive but for governments, industry and the world's citizens it is a price worth paying

By Richard Willsher

According to research by the International Energy Agency, it will cost USD 316tn to achieve a 50 per cent global reduction in carbon emissions by 2050. In addition the Paris-based intergovernmental energy policy advisor reported in its World Energy Outlook 2009 publication that, "Every year of delay in global efforts to mitigate climate change adds an extra USD 500bn to the clean energy investment needed by 2030."

The heat is being turned up in more ways than one and yet in the wake of the financial crisis, private investment in new clean energy technologies has sagged. Where then is the necessary funding going to come from?

#### GOOD VALUE

Although these are massive, incomprehensible numbers for most people, renewable energy experts are sanguine about the

world's prospects for stumping up the cash. Nick Robins, head of HSBC's Climate Change Centre points out that it is the nature of the move to low carbon power generation that the up-front investment numbers are large. But once made, low operating costs, for example for wind powered turbines or wave or tidal electricity generation projects, mean the benefits will quickly start flowing. These include, among others, savings on the price of energy, better air quality and energy security. Robins says that therefore although initial costs are high they are affordable.

However, governments must engage with the investment community if internationally set targets are to be achieved. Robins adds that the private sector is likely to have to foot the bill for 80-90 per cent of up-front costs. And by this he means for example that when you or I pay a higher price for our energy efficient light bulbs or our hybrid cars we are effectively playing (and paying) our part. Scale up to industry and the cost of fuel-efficient plants or vehicles or environmentally

friendly buildings is also part of this.

Which is by no means to underestimate the role played by governments whose job, it must be said, is to redistribute and redirect our taxpayers' cash into low carbon environmental and energy policies. The implementation of grants and so-called "feed in" tariffs encouraging the domestic use of solar panels to generate power are examples of how government can subsidise the uptake of clean energy on the micro level.

#### MORE CARROT

The key word here is "incentive". There have to be incentives to persuade everyone from private consumers to industrial giants to take part in the move to low carbon, renewable energy. Peter Hindle-Marsh, who is director of investment and finance at Clean Energy Capital, a firm which secures private investment for clean energy and environmental technologies, says that while entrepreneurs are investing in new technologies, the incentives to do so need to be improved.

It seems likely that the coalition government will have to do more to incentivise the private sector

#### FULLY BAKED

Professor Jim McDonald, Principal of the University of Strathclyde, a leading expert on power generation, highlights the importance of the private sector putting together "high quality, investment-ready" proposals to the financial community. Half-baked, back of envelope, ideas will be unlikely to attract financial support.

He goes on to scope out an optimistic, international vision. He underlines the importance of cooperation between governments, industry and citizens lead by strong policy incentives. He also favours a diversity of power generation from local to national and international scale including solar, wind, tidal, wave, biomass, gas and nuclear sources.

McDonald also calls for acceptance that investment of the scale required can be boosted if sovereign wealth funds from countries such as China, those in the Middle East and other emerging markets become involved. The benefit of investment is the development of new technologies and means of distribution; the price will inevitably involve sharing resources and assets. Those countries that choose not to form such partnerships fearing a loss of energy security may be the losers, he argues, given the high cost of investment and the need to harness the best, most efficient technologies.

This is a powerful vision and for some an uncomfortable one. Yet carbon emissions are a global phenomenon and only global cooperation on their clean up and the development of new energy sources can address them effectively. The consensus that emerges from among experts in the quest for renewables is one that is generally optimistic in spite of the huge cost. That optimism is grounded in a belief that this is a price that we all have to pay. The cost, in economic and, significantly, human terms of going any other way is simply too high to contemplate.

Venture Capital Trusts are now of no real use, Hindle-Marsh says. Raising capital gains tax does not encourage such investment. New measures are needed to unblock the very large amounts of private cash waiting in the wings to invest in worthwhile, remunerative projects. Moreover, the UK government along with other EU member states is tasked with submitting a report to Brussels on its progress towards meeting EU emissions and renewable energy targets by the end of 2011 and every two years after that. It seems likely that the coalition government will have to do more to incentivise the private sector.

Meanwhile project sponsorship is likely to come from big hitters in the private sector provided they can access finance. "The funding to develop the renewable energy sector will come from major multi-national energy companies such as Centrica, Eon and Statoil - in effect the world's biggest energy providers," says Sam Pick, director of the Renewables Network, an organisation involved with the growth in the offshore wind industry in Humberside and the North East. "Similarly, manufacturing will be supported by world-leading companies such as Siemens, General Electric and Mitsubishi, to name just a few." But in the current economic climate, investment finance is hard to come by.



# The Global Centre of Future Energy



Masdar City is an emerging clean technology hub in Abu Dhabi, UAE. Organizations and institutions from around the world are coming here to pioneer solutions to the global energy challenge. With access to key international markets, funding and investment, and a skilled, specialist talent pool, Masdar City creates an environment where innovation and entrepreneurialism flourish.

To find answers and partner with us, visit us at the European Future Energy Forum, Excel, London 19 – 21 October, 2010 or email [joinus@masdarcity.ae](mailto:joinus@masdarcity.ae)

[www.masdar.ae](http://www.masdar.ae)

## Taming the megacity

The future of cities could be cleaner and greener if smart technology is deployed effectively. It makes economic as well as environmental sense, says Siemens' Juergen Maier

Cities are the way of the future, the only model in which ten billion people can live productively on the planet. But cities are engines of climate change, sucking in energy and water and spewing out greenhouse gases.

Futurologists regard taming the megacity as one of the sternest challenges facing humankind. For Siemens, with its innovative solutions for energy, industrial infrastructure, transportation and building technologies, it's an opportunity...

"We have made it one of our core initiatives," says Juergen Maier, MD of Siemens Industry Sector in the UK. "We aim to help make the cities of the future cleaner, greener and more environmentally friendly places."

Mr Maier has a vision of a 'smart city', highly interconnected by grids carrying data and energy but very localised, with individual buildings generating much of their own power from renewable sources and deriving a large portion of their water from rainwater capture and recycling.

"The future is about buildings not using as much energy, and generating their own power using solar panels, micro-wind turbines, ground heat and so on," Mr Maier says.

Siemens is a world leader in renewable energy, with more than 8,000 wind turbines in operation worldwide. Meanwhile, 500 of its advanced gas turbine can supply power to 100 million people.

High technology electricity power networks slash the losses involved in transporting the power to where it is needed, and LED light bulbs from OSRAM (a Siemens company) consume 80 per cent less energy than a conventional bulb. Smart cities will be much less dependent on hydrocarbon fuels, using electric vehicles instead, Mr Maier predicts.

"This is already beginning with hybrid systems arriving in buses and cars," he says. In transport, Siemens is installing light rail systems all over the world and its Desiro City commuter train is 25 per cent lighter than current rolling stock and can run on

**'The main obstacle is getting people to understand what is possible with the technology'**



Next generation trains

half the energy.

Siemens also builds the world's fastest series production train, the Velaro, which uses only a Coke can's worth of fuel per 100-passenger kilometre. The company is also working on the infrastructure for electric vehicles, a vital first step to enable electricity to replace hydrocarbon fuels on the roads. The aim is to provide networks of intelligent charging points that can also use the batteries to store power to smooth out local power spikes.

The world faces a looming water crisis, which requires advanced technology in

several areas. One is to increase supply by desalination, reducing water consumption is another, and recycling is a third. Industry also faces ever-tighter regulations on waste water effluents. Siemens can help in all areas. The challenge now is to persuade people that smart green technology already makes economic sense, Mr Maier believes: "The main obstacle is getting people to understand what is possible with the technology, so they can make a business case for adoption. Lack of understanding is making it difficult to raise finance for environmentally-friendly projects."

## ASK THE EXPERT &gt;&gt;

# Three experts share their views on how business and wider society must face up to the energy challenges ahead

**ALAIN GLATIGNY,**  
Innovation Energy Manager,  
Schneider Electric



**Q: WHAT ARE THE DIFFICULTIES OF INTEGRATING RENEWABLE ENERGY INTO THE GRID?**

A: Europe's leaders are committed to the 20-20-20 targets on climate and energy use. Integrating energy from renewable sources is one of the main technical challenges. Renewable energy is unpredictable and it is difficult to match supply with demand, which makes the planning of the grid dispatcher more complex. Renewable energy creates a bi-directional flow which has implications for network protection, voltage regulation and islanding. The key challenge is to find affordable solutions which will allow the integration of any type of renewable energy at any location on the grid and provide the means to control the load, depending on the available power.

**Q: WHY IS NETWORK STABILITY IMPORTANT AND HOW CAN IT BE ACHIEVED?**

A: A high rate of renewable energy distributed on the grid coupled with changes in customer usage can create instability on a network. The result could be black-outs, regionally or nationally, which is obviously bad for the economy. Network stability can be controlled on two levels: at transmission level, and at distribution level, by controlling the loads and distributed generators. So ancillary services which contribute to network stability, such as active-reactive power management, will definitely become more valuable.

**Q: WHAT IS 'DEMAND SIDE MANAGEMENT' AND HOW DOES IT AFFECT THE NEED FOR NETWORK MANAGEMENT?**

A: Demand side management (DSM) means taking actions which respond to how much energy is consumed and also to the pattern of use. It can mean, for example, taking steps to reduce demand at peak times.

It requires an efficient communications infrastructure to link the demand, supply and market sides. It's a great opportunity for operators to make more intelligent use of existing assets, using 'smart grid' technologies, such as grid automation and networking management.

**DR SULTAN AL JABER,**  
Managing Director and Chief  
Executive Officer of the  
major cleantech development  
company, Masdar, UAE



**Q: WHAT ROLE CAN MASDAR PLAY IN BRINGING NATIONS TOGETHER AND CO-ORDINATING POLICY ON RENEWABLE ENERGY?**

A: The leadership of Abu Dhabi realise the importance renewable energy will play in meeting future global energy needs. Through Masdar, Abu Dhabi has invested in a strategic and comprehensive initiative dedicated to all aspects of renewable energy.

Masdar, through global partnerships and collaboration, is making significant advances in the areas of energy security, climate change and sustainable human development. Events such as the European Future Energy Forum and the annual World Future Energy Summit in Abu Dhabi serve as ideal platforms for Masdar to secure long-term strategic partners for the joint development of renewable energy technologies.

**Q: WHAT AREAS OF POTENTIAL CO-OPERATION ARE THERE BETWEEN MASDAR AND EUROPE, PARTICULARLY THE UK?**

A: In Europe our focus is mainly on developing cooperation across R&D, venture capital investments in cleantech and climate change mitigation plans, as well as large scale deployment of renewable energy technology.

The London Array, a joint venture between DONG, E.ON and Masdar, will be the world's largest wind farm, providing enough energy to power around 750,000 homes in Greater London, around a quarter of the total.

**Q: HOW WILL THE DEVELOPMENT OF CLEAN ENERGY MOVE FORWARD IN THE NEXT FEW YEARS?**

A: Clean energy has the ability to mitigate climate change, establish new economic sectors, revive failing economic sectors and help meet global energy requirements without sacrificing economic growth and human progress.

**Q: WHY IS THE UNITED ARAB EMIRATES A GOOD PLACE TO INVEST IN CLEAN ENERGY SOLUTIONS?**

A: There is no equivalent to Masdar anywhere, either in scale as a test-bed or in the comprehensive nature of the approach. Masdar offers an unparalleled investment portfolio with access to human capital and R&D capabilities, entirely dedicated to clean energy solutions.

**MATTHEW CHINN,**  
Managing Director Siemens  
Energy Sector and Sector  
Lead, North West Europe



**Q: WHAT IS THE MAJOR CHALLENGE FOR THE ENERGY INDUSTRY IN A LOW-CARBON FUTURE?**

A: To decarbonise energy generation rapidly while maintaining energy security. Electricity consumption is expected to rise by more than 60 per cent by 2030 and our new generating capacity will need to be a mixture of technologies, such as wind power, nuclear, clean coal and biomass.

**Q: HOW CAN NEW TRANSMISSION TECHNOLOGY HELP ADOPTION OF RENEWABLE ENERGY SOURCES?**

A: New transmission technologies such as high voltage direct current (HVDC) enable electricity to be moved across longer distances with up to 40 per cent fewer losses than AC technologies. This allows the industry to generate electricity in more remote locations and efficiently transmit it to where it is needed. So for wind energy, where Siemens provides more than 40 per cent of wind turbine generating capacity in the UK, HVDC technology will enable wind farms to be established further offshore.

**Q: HOW CAN THE GROWTH IN ENERGY CONSUMPTION BE MANAGED EFFICIENTLY?**

A: Smart grid applications will help manage future consumption. For example, digital smart meters tell consumers when they are using high-cost electricity, so they can adjust their consumption and use less power at peak times and save money. Trials with smart meters have demonstrated that consumers and business users become highly motivated to save electricity when they know how much they are using from moment to moment.

**Q: WHAT CHANGES CAN WE EXPECT TO THE ENERGY SUPPLY CHAIN IN THE FUTURE?**

A: Undoubtedly e-cars and smart grid applications will be the greatest changes. Besides changing the way we travel, e-cars could also be used to help balance electricity peak supply and demand. The batteries in e-cars could be used to store electricity during periods of low demand and if the car is not being used, the electricity could be released into the grid during periods of high demand.



# Pioneers in the green revolution

The Masdar Institute aims to become a world leader in the scientific research that underpins sustainable technologies

Scientific research is vital to the development of the sustainable technologies that will address the issues of climate change and enable the world population to live well on a small planet. The new Masdar Institute of Science and Technology is already contributing to the advance of knowledge in the area.

The institute, based in Abu Dhabi, UAE, is the world's first postgraduate school specialising in sustainable technologies, including water, renewable energy, microelectronics, green building systems, smart power grids and information networks.

This is only its second academic year but faculty members are

already involved in over 30 research projects and have filed several patent applications.

"We are building a world-class research institute that will help establish the scientific foundations of the sustainability revolution," says Dr Fred Moavenzadeh, the institute's president.

Dr Moavenzadeh has a long track record of success in helping to build new research facilities as director of technology and development at the Massachusetts Institute of Technology. MIT is also one of the rich network of academic and industrial research partners that Masdar Institute has adapted. All faculty members spend up to a year at



Students from over 25 countries attend the world's first graduate research-driven university for sustainable technologies

MIT developing course materials and joint projects with MIT researchers.

Dr Moavenzadeh expects partnerships with industry to fund growth of the institute.

"Our model is to work together to create economic growth by the development and sale of intellectual property," he says. "The Masdar Institute is an open platform for collaboration and partnerships. Joint research with academia, industry and other R&D partners is central to our collaborative philosophy, ensuring all research is closely aligned to the needs of government and industry

and delivering real world impact."

One of the first collaborative initiatives is a pilot project to create biofuel using algae in mangrove swamps as the raw material. The industrial partner, Boeing, hopes it will develop into a sustainable source of aviation fuel that will not compete with food production.

Through collaboration with ATIC (Advanced Technology Investment Company), the Masdar Institute has developed an advanced microelectronic academic programme as well as one of the world's best equipped laboratories. The institute is uniquely

positioned in Masdar City, which is planned to be the world's first zero-carbon city and a major hub of the new sustainability industry.

As construction proceeds over the next decade, the institute will contribute to the Masdar City design process and will help monitor the effectiveness of the new technologies that will be used. It also expects to benefit from the many innovative companies in the sustainability sector that will be based there or have their Middle Eastern headquarters in the city.

"We will have a whole city as our laboratory," Dr Moavenzadeh says.

The Masdar Institute will not just be developing individual technologies, however. Multidisciplinary research programmes will examine the integration of technology, policy and systems to promote a concerted, coordinated and effective response to the challenges of climate change and population increases.

"The opportunity to test and deploy new technologies on an unrivalled scale in Masdar City will ensure that the Masdar Institute will become a global source of innovation and original thinking," Dr Moavenzadeh says.

## LEARNING TO CHANGE THE WORLD

At Masdar Institute of Science and Technology a generation of emerging scientists is learning to change the world.

### A WORLD-CLASS GRADUATE-LEVEL UNIVERSITY

At Masdar Institute passionate students and faculty are working at the cutting edge of research to tackle the toughest global challenges. Developed in collaboration with the Massachusetts Institute of Technology (MIT), Masdar Institute is an independent, not-for-profit graduate-level university dedicated to research and development of alternative energy, environmental technologies and sustainability.

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## SUSTAINABLE LIVING &gt;&gt;

# Eco-city: Not in my backyard?

Despite the enthusiasm for eco-buildings in some quarters, the vision of a whole sustainable city will not be realised overnight

By John Prosser

From biomass, solar and electric vehicle technology to a teleconferencing facility in every home, will our future towns and cities deliver a sustainable paradise? Or will we be slaves to a new urban sprawl dictated by regulation, compromise and political expediency?

Where do you go to find an exemplar of modern eco-building excellence? Try Watford, where you can visit the British Research Establishment (BRE) Innovation Centre, which includes The Natural House, a joint project with the Prince of Wales' Foundation for the Built Environment. The building, made from natural materials, boasts as its eco-credentials that it will reduce the community footprint; be of low impact and long life; deliverable and desirable; and be simple and replicable on an ordinary building site.

The BRE is a world-class standard bearer for eco-building, but currently there may be more eco-homes in museums than on local building sites. It's one thing to create one green building or even a block of them; it's quite another to create and sustain a whole city.

Richard Register coined the term 'eco-city' in his 1987 book *Ecocity Berkeley*. In his March 2009 interview with Sustainable City Blog, he captured one of the major difficulties faced by those who would create our cities of the future. "There are many supposedly wonderful examples of great buildings getting the limelight – but to drive out to them completely destroys whatever 'sustainability' they were supposed to embody . . ."

Register is avowedly 'anti-car' and currently it is hard to imagine a city which is not, to some degree, the slave of the internal combustion engine, even if one is only thinking of emergency services, maintenance and goods vehicles. Asked to define 'an eco-city' Register says it is, "an ecologically healthy city. That also means the city design is strongly informed by knowledge of ecology and its design principles."

Those who have become involved in the design of new eco-cities, like Foster & Partners and Arup would surely agree, but the challenges are apparent when you look at current and attempted sustainable



German Chancellor Merkel discusses a model of Masdar City earlier this year

credit: Guido Bergmann-Pool/Getty Images

## Three-quarters of the British development industry believe the government's zero carbon goal for the sector is unrealistic

city projects in the UK, in Europe and worldwide.

Masdar City, in Abu Dhabi; Dongtan, the apparently stillborn sustainability project on Chongming Island in the mouth of China's Yangtze River; and Songdo International Business District in South Korea, where every home is expected to have a 'telepresence unit', bringing a life-size virtual world into the home, must all conquer the challenges posed by the internal combustion engine if they are to achieve their potential.

Doubt now hangs over the future of the ambitious Dongtan development. The city, designed by engineers Arup, was originally expected to produce its energy from renewable sources.

"Waste from rice production can be burnt in a biomass plant to create steam, which then creates electrical energy to power everything in the city," says Roger Wood, a director at Arup, of the Dongtan project. "We've got power from a mixture of rice husks, solar and wind. We can also digest sewage and waste materials into methane

gas, which can then be used to create electricity."

But will the project see the light of day? No construction has commenced to date.

So, to what extent will our future cities benefit from truly innovative carbon-saving technology? Cisco, which has developed the TelePresence conferencing system, is reported to have saved \$615m on travel and more than 332,000 tonnes of emissions by using the system. The company hopes the technology will ultimately transform consumer behaviour in sustainable cities.

Marthin De Beer, Cisco's Senior Vice President of Emerging Technologies, says: "If you've been to Songdo in Korea it's amazing what is going on there. Every home will have a TelePresence unit built in like a dishwasher . . . because that is how education, health care and government services will get delivered right into the home. It will come to you. You don't have to go find it. And that is how they will reduce traffic congestion and pollution in the cities."

Back in the UK, questions hang over whether the UK government will meet its zero carbon building goals. According to a recent survey, *Hitting the Green Wall . . . and Beyond*, three-quarters of the British development industry believe the government's zero carbon goal for the sector is unrealistic.

The survey of 7,000 industry insiders, published in June 2010 in a joint venture between the British Property Federation, international law firm Taylor Wessing, and

consultancy Spada, found that there was scepticism throughout the UK development industry of the government's policy objectives.

Some 76 per cent of respondents believed plans to make all new housing zero carbon by 2016 were unrealistic, while 73 per cent said plans to make new commercial properties zero carbon by 2019 are also unrealistic. But respondents did believe the 'stick' of regulation was most likely to drive progress in future, highlighting the need for closer industry-government collaboration.

In a global economic and political climate in which public funds to bolster a global property downturn are scarce, does the political will remain to foster the sustainable dream?

According to a recent report from specialist magazine *Inside Housing*, the UK government has, unannounced, halved the funding available for eco-towns, the major building project first announced in 2009. When first launched, the project garnered significant local opposition, and the magazine further reports that the whole exercise may be re-branded and made lower key after the Office of Government Commerce, an independent branch of the UK Treasury, has conducted a review to ensure that the proposed £35 million programme can meet its aims.

The seeds of our future eco-cities can be seen all around us, but it looks as if it will be some time before they bear fruit.



# Charging beneath the sea

A new device that harnesses the power of waves underwater could soon be generating electricity off the coast of Britain

A revolutionary wave power generator that operates underwater has begun trials off the coast of Italy – and could soon be generating electricity near Land’s End.

Existing offshore wave power devices float on the surface where they are exposed to the full fury of every storm and must be engineered to withstand hurricanes. Below the surface, however, wave energy decreases exponentially, dwindling to almost nothing by about half a wavelength down.

Invented by Dr Michele Grassi of 40South Energy, the new device is tethered to the seabed and moves

automatically up and down to find the depth at which it generates power most efficiently.

“It is a hybrid between a pontoon and a submarine,” says Dr Grassi.

When the device finds its own level, electricity is generated by the motion of floats pulling wires through generators in the ‘submarine’.

One of the main characteristics of the system is that it experiences only Mediterranean-strength waves even in the notoriously surging waters of the Pentland Firth, because it moves down until the wave energy is at the right level, Dr Grassi explains. “Other



40South’s ‘hybrid’ wave power generator

wave machines are on the surface, so they take the full force of any storm.”

The device also almost never stalls, he says, and can be directed to dive to the bottom if a severe storm is predicted or a ship strays into the area. Because the units do not have to be made to withstand hurricanes, they are cheap to build and easy to install and maintain.

Dr Grassi chose to base 40South Energy in London because the UK

leads in wave power technology and is also one of the best places in the world to exploit the power of the sea, he says – “Wave energy is a UK business, it started here.”

The next step is to locate a submarine power station at the new Wave Hub in Hayle, Cornwall, a subsea electrical connection point that will allow competing wave energy devices to generate power for several years. It is expected to become operational in 2011. “We

The units do not have to be made to withstand hurricanes, so they are cheap to build and easy to install

are in discussions with the Wave Hub in Cornwall to run a pilot facility there,” Dr Grassi says.

Once the technology has been tested, the ability to make standard submarine power stations and install them all over the world, regardless of the severity of conditions on the surface, could make 40South Energy the world’s first mass producer of wave energy technology.

Dr Grassi expects the devices to be used to provide renewable energy at high latitudes and drinking water and renewable energy at lower latitudes: “It is a perfect fit with desalination plants, because you don’t care if it is not running 100 per cent of the time. You can still produce all the clean water you need, as you can store it when waves are present and use the stored one when there are no waves”.

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## GREEN VEHICLES &gt;&gt;

# 'Clean' TRANSPORT MOVES UP A GEAR

As cycling commuters, hybrid and even electric cars challenge their fossil fuel-driven counterparts for space on our roads, is the vision of 'clean transport' becoming a reality?

By Richard Brass



BMW's 'Vision' hybrid concept car at the Auto China motor show in April this year

credit: JOERG KOCH/AFP/Getty Images

**C**lean transport has long been an ambition of environmentalists, planners and plenty of ordinary citizens. After decades in which major centres have been dominated by internal combustion engines with their noise, pollution and CO<sub>2</sub> emissions, the prospect of quieter, cleaner and less carbon-intensive forms of mobility has been an enticing goal, but one that has seemed distant.

Recently, however, the picture has changed. A combination of new public attitudes to the environment, technological developments and improved market conditions suggest that clean transport may be approaching the point at which it will turn from a matter for discussion into concrete reality.

The motivation from government is clear. The UK Climate Change Act has set a target of an 80 per cent reduction in greenhouse gas emissions by 2050. With transport making up 21 per cent of the country's total domestic emissions, low-carbon solutions are already receiving government encouragement and are likely to receive more, motivating both consumers and businesses to respond.

Meanwhile, local authorities have made loud and determined statements about their plans for cleaner transport. Electric vehicles have appeared on the streets. Cycling has gone from being an activity for only the bravest to a

standard form of commuting. And the prospects for alternative fuels are no longer only the subject of academic discussion but the topic of regular public debate. Is the shift away from internal combustion finally occurring?

## HYBRID MARKET

Electric vehicles are a particularly promising area of progress. Although still relatively rare and usually seen only in big urban areas where slower traffic speeds suit them, they are becoming more common and car manufacturers are increasingly confident about putting new models on the market.

The key step towards making the widespread take-up of electric cars a reality has been the growth in the market for hybrid vehicles which use a mix of petroleum and electric power. More than 650,000 hybrids were sold around the world last year, showing that the idea of unconventional power sources has been broadly accepted. The current market for electric cars is minute by comparison: last year only 5,000 electric vehicles were sold globally. However, boosted by the success of hybrids and of pioneering electric vehicles such as the G-Wiz, an increasing number of manufacturers are venturing into the market. Citroen, Peugeot, Nissan and Mitsubishi are among the makers that have recently launched electric models.

Some companies are also working on the infrastructure needed to make broad take-up of

electric vehicles feasible. Renault recently established an e-mobility project in the Rhine-Ruhr region of Germany and Audi has just launched a programme to install 200 new charging stations in Munich.

## The scope for electric vehicles to reduce CO<sub>2</sub> emissions depends primarily on the way their electricity is generated

Nick Robins, head of HSBC's Climate Change Centre of Excellence, says he expects 8.65 million electric vehicles to be sold globally in 2020, alongside 9.23 million hybrids.

"An important advantage of electric vehicles over conventional internal combustion engines is very high energy efficiency, low-cost motors and low running costs," he says. "Mass deployment of electric vehicles powered by low-carbon electricity generation also offers the potential to reduce significantly greenhouse gases from transport fuels, without substantially increasing power consumption."

## HOW CLEAN IS CLEAN?

Ultimately, the scope for electric vehicles to reduce CO<sub>2</sub> emissions depends primarily on the way their electricity is generated. Calling a form of transport 'clean' is questionable if it's being powered by a coal-fired power station. For this reason, the development of alternatives to fossil fuels has long been held up as the cleanest and most sustainable solution to the transport challenge.

The UK has signed up to the EU's target of ensuring that 10 per cent of transport fuels come from renewable sources by 2020, and the Government has said that nearly all of this will be in the form of first-generation biofuels. A UK network of refineries for turning wheat into biofuel is being developed, Shell recently signed a \$12 billion joint venture to form the world's biggest bioethanol producer and a number of transport fleet operators have begun incorporating at least some biofuel in their mix.

However, this solution, that only a few years ago appeared as the most likely to provide clean, low-carbon transport, is now running into serious opposition. The key problem is that feeding the biofuel plants is in direct competition with the food industry, and thus has an impact on food prices. The three UK wheat-based biofuel refineries expected to be operating by 2014 will require 20 per cent of the UK's wheat crop, and the

World Bank, the OECD and the UK government's Gallagher report have all identified biofuels as a significant factor in recent food price rises around the world.

Besides these economic pressures, the environmental threat posed by the need to create more cropland to produce fuel has turned most of the environmental lobby strongly against biofuel. Innovations in finding sources of biofuels may change the picture, but for now these controversies have put biofuel's prospects as the likely solution to the transport challenge into question.

Other technologies that could one day contribute to cleaner transport, such as hydrogen fuel cells, are still in their relative infancy compared to biofuels and electric vehicles, both technologically and in terms of take-up. In London, for example, the Mayor has a plan for 25,000 electric vehicle charge points by 2015 and wants to see 100,000 electric vehicles on the streets, along with 300 hybrid buses by 2012. However, only five hydrogen fuel cell buses are being trialled in the capital over the next three years. For the moment at least, the future looks electric.





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# Europe unveils action plans

EU members' proposals for providing 20 per cent of their energy from renewable sources by 2020 are full of promise but does the community have the will and the cash to realise them?

By John Prosser

"Europe needs to think about developing renewables, not just in terms of climate change but also as just plain and simple self-interest in competitive global markets."

So said Philip Lowe, European Commission Director General for Energy, at a recent Friends of Europe debate. He may have been stating the obvious, but there are certainly strong commercial reasons for advancing renewable energy sources as rapidly as possible among the countries of the European Union.

The EU countries are global leaders in the development and application of renewable energy, vital for both reducing the EU's dependence on external energy imports, and in meeting targets to combat adverse global climate change.

While Germany and the United Kingdom may currently be the only members of the EU on track to achieve the objectives set by the Kyoto Protocol on climate change, the recent delivery by the majority of the EU nations of their renewable energy action plans, under the Renewable Energy Directive, is at least another step in the right direction.

The directive required each European member state to provide a national renewable energy action plan by 30 June 2010. Only two plans had arrived on the European Commission's desk by noon on deadline day, though most of the 27 members have now submitted their plans. So far, all the documents published highlight plans for significant increases in renewable energy capacity, primarily but not exclusively built around the rapid expansion of onshore and offshore wind farms.

Germany is forecast to increase its onshore wind capacity by 30 per cent over the next decade, while onshore wind capacity will grow by 130 per cent in Ireland, 230 per cent in Italy and 74 per cent in Spain.

Offshore wind capacity is expected to grow from close to zero to around 10,000MW for Germany, 2,300MW for Ireland, 1,000MW for Italy and 3,000MW for Spain. Solar power is also expected to



The EU aims to be a global flag-bearer for renewable energy

credit: JOHN THYS/AFP/Getty Images

## 'Will new homes have to be zero carbon by 2016? The industry needs to know, and soon'

rise almost 3,000 per cent in Spain and a massive 500 per cent in Italy with Eastern European states such as Poland and Bulgaria reported to be planning a significant increase in biomass.

The European Renewable Energy Council (EREC) has welcomed the plans, saying that the 20 per cent target was technically feasible and would provide a significant boost to the European economy in terms of revenue and job creation. "EREC is convinced that member states recognise the benefits of ambitious renewables policies, enabling a fast-growing industry to make the necessary investments to maintain the EU's global leadership and create new jobs," said EREC policy advisor Lucie Tesnière. "EREC firmly believes that the EU 27 can reach at least 20 per cent by 2020 – domestic action will bring domestic benefits for European companies, citizens and society at large."

The UK's Coalition Government has published its submission to the European Commission setting out how the UK plans to meet its 15 per cent renewable energy target. But while it says it is confident it can meet its target for 2020 with a three-point framework of action, it admits it has to "radically increase" its use of renewable

energy as it describes climate change as "one of the gravest threats we face".

The 'lead scenario' set out in the UK plan indicates that it is possible to achieve the 15 per cent target and provides one technological combination for 2020. But this scenario does not represent a target for any particular sector or technology and is not seen as an upper limit to the UK's ambition for renewables deployment.

The action plan re-affirmed the UK's current position with renewable energy, saying, "the UK has been blessed with a wealth of energy resources. Until now we have relied on the use of our coal, oil and gas supplies to supply our homes; support our businesses; and power our transport. As we look forward, we need to ensure that we also make the most of our renewable resources to provide a secure basis for the UK's future energy needs."

The report says that the total renewable capacity of the UK will be 38.21GW, made up of the clean technology applications and highlights three key areas as the basis for UK renewables policy:

- financial support for renewables
- unblocking barriers to delivery
- developing emerging technologies

The report adds: "Offshore wind is a key area for development. We will work to develop an offshore electricity grid to support our continuing commitment to being world leaders in this technology. This

new generation of offshore wind power will play a key role in meeting our 2020 target."

The report also includes plans for a Green Investment Bank, an extended feed-in tariff scheme for renewable electricity, and reforms to the planning system.

But Gaynor Hartnell, CEO of the Renewable Energy Association, highlighted a number of questions, saying: "There are still many questions hanging in the air – can new power projects move ahead in confidence that their revenue streams won't be undermined by a move to feed-in tariffs? Can businesses start planning for the introduction of a renewable heat policy next April? Will new homes have to be zero carbon by 2016? The industry needs to know, and soon."

And there are economic, political and administrative constraints. Adam Brown, senior energy analyst at the International Energy Agency, says the world is spending just half of the money necessary to meet climate goals. Global investments to achieve the climate goal should be \$239 billion per annum to 2030. But current spending is around \$110 billion.

Dow Corning's Eric Peeters argues that a major obstacle to the development of photovoltaic power lies in administrative barriers with the acquisition of permits causing delay in certain areas.

Nevertheless, in spite of the questions, there is evidence of optimism that real progress can now be made. This, at least, is a breath of fresh air.



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