Making It
Industry for Development
Number 2

- Bianca Jagger: After Copenhagen
- Suntech Power
- Energy transitions for industry
- Carbon capture and storage

Wind of change

Issue 1, December 2009

- Rwanda means business: interview with President Paul Kagame
- How I became an environmentalist: A small-town story with global implications by Phaedra Ellis-Lamkins, Green For All
- 'We must let nature inspire us' – Gunter Pauli presents an alternative business model that is environmentally-friendly and sustainable
- Old computers – new business. Microsoft on sustainable solutions for tackling e-waster
- Green industry in Asia: Conference participants interviewed
- Hot Topic: Is it possible to have prosperity without growth? Is 'green growth' really possible?
- Policy Brief: Greening industrial policy; Disclosing carbon emissions

A new quarterly magazine. Stimulating, critical and constructive. A forum for discussion and exchange about the intersection of industry and development.

Editorial

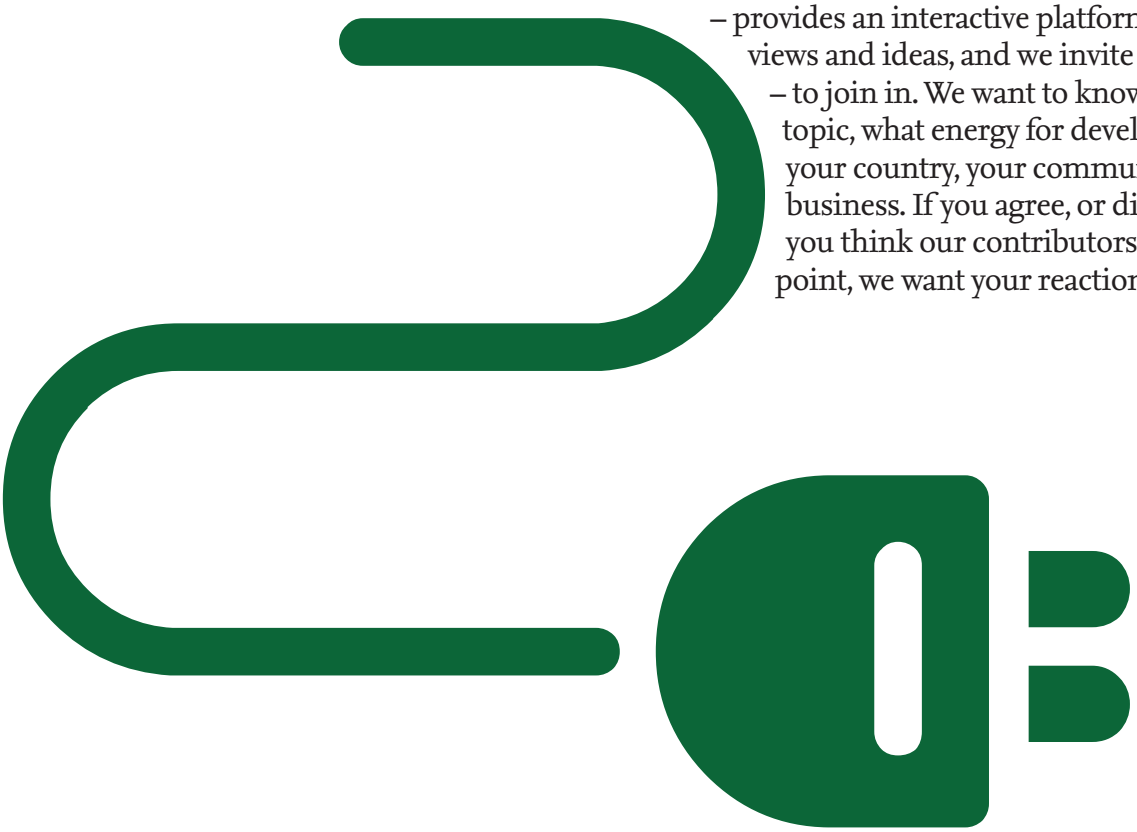
The theme of this – the second – issue of *Making It: Industry for Development* is energy, specifically the provision of energy to spur sustainable development, to facilitate productive activities by powering tools, machinery, and manufacturing processes in ways that will cause less – ideally no – damage to our environment.

The world cannot address the threat of climate change without dealing with the issues of energy access and energy solutions. We cannot fight poverty without creating wealth, and it's not possible to create wealth without a cheap source of energy to power economic activities. And we can't achieve any of the Millennium Development Goals without improving access to affordable and reliable sources of energy.

What are the renewable energy options for developing countries? How can industries across the globe increase output to meet a growing demand while, at the same time, reduce greenhouse gas emissions? What needs to be done to give the world's poorest people access to energy, and how can it be done?

Energy for development is a vast topic, and *Making It* hopes to act as a thought-provoker, and as a catalyst for a wider and deeper discussion and debate.

Making It's new website – www.makingitmagazine.net – provides an interactive platform for exchange of views and ideas, and we invite you – our readers – to join in. We want to know how you see this topic, what energy for development means to your country, your community, your business. If you agree, or disagree, or even if you think our contributors have missed the point, we want your reactions, your response.



MakingIt
Industry for Development

Contents

Editor: Charles Arthur
editor@makingitmagazine.net
Editorial committee: Ralf Bredel, Tillmann Günther, Sarwar Hobohm, Kazuki Kitaoka, Ole Lundby (chair), Cormac O'Reilly
Cover illustration by Patrick Chappatte – www.globecartoon.com
Design: Smith+Bell, UK – www.smithplusbell.com
Thanks for assistance to Lauren Brassaw, Donna Coleman, and Daisy Lau C.F.
Printed by Imprimerie Centrale S.A., Luxembourg – www.ic.lu on PEFC certified paper
To view this publication online and to participate in discussions about industry for development, please visit www.makingitmagazine.net
To subscribe and receive future issues of *Making It*, please send an email with your name and address to subscriptions@makingitmagazine.net
Making It: Industry for Development is published by the United Nations Industrial Development Organization (UNIDO)
Vienna International Centre,
P.O. Box 300, 1400 Vienna, Austria
Telephone: (+43-1) 26026-0,
Fax: (+43-1) 26926-69
E-mail: unido@unido.org

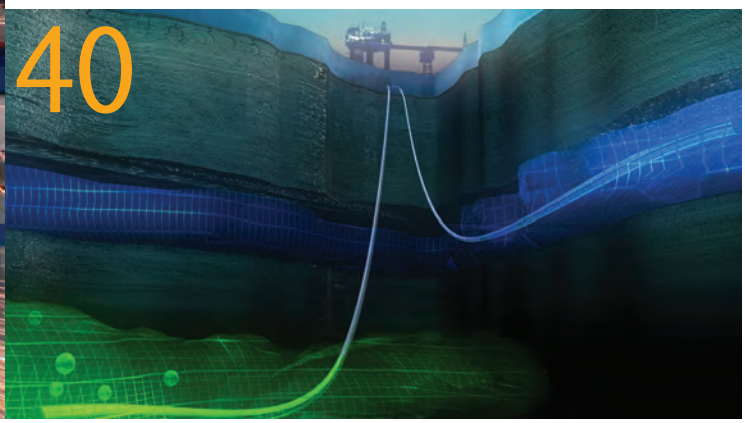
ISSN 2076-8508

30

16

22

19



40

GLOBAL FORUM

The Global Forum section of *Making It* is a space for interaction and discussion, and we welcome reactions and responses from readers about any of the issues raised in the magazine. Letters for publication in *Making It* should be marked 'For publication', and sent either by email to: editor@makingitmagazine.net or by post to: The Secretary, *Making It*, Room D2226, UNIDO, PO Box 300, 1400 Vienna, Austria. (Letters/emails may be edited for reasons of space).

To provide a platform for further discussion of the issues raised in *Making It*, a magazine website has been created at www.makingitmagazine.net and readers are encouraged to surf on over to the site to join in the online discussion and debate about industry for development.

LETTERS

Microsoft and e-waste

I am surprised to see that *Making It* (Issue 1, December 2009) has Microsoft writing about e-waste. Greenpeace has just released its newest *Guide to Green Electronics*, evaluating the top 18 manufacturers of personal computers, mobile phones, TVs, and games consoles based on their policies on toxic chemicals, recycling and climate change. Microsoft drops two places since the last evaluation, and is now in place 17 of 18 companies!

The Greenpeace report states that: "On e-waste, Microsoft has now engaged in an EU coalition supporting Individual Producer Responsibility... (but) on other e-waste criteria, Microsoft fails to score any points."

Specifically it states, "Microsoft provides links to various recycling initiatives by Microsoft (MAR, Digital Pipeline), other organisations (eg. CEA's myGreenElectronics) and other electronic manufacturers, but it still does not provide free take-back for its own products." And continues, "Microsoft is using recycled plastics in product packaging films but no details are given about its use in hardware products."

● **Constantine Simpson, received by email**

A Microsoft spokesperson sent the following response: *Microsoft's commitment to environmental sustainability includes strategies to minimize the impact of our operations; using IT to improve energy efficiency; and accelerating research breakthroughs that will help scientific understanding on a global scale. We acknowledge that more work remains to achieve our sustainability goals and continue to work to improve upon our efforts.*

In our consumer electronics business, we comply with or exceed all applicable environmental guidelines and regulations. We are committed to making progress on environmental issues without detracting from the durability, safety, performance, and affordable cost that consumers demand. We constantly look for ways to be more efficient, use fewer materials, and always seek continuous improvement, while keeping quality up and cost down. Moreover, we have eliminated substances and reduced materials without sacrificing our commitment to consumer safety, innovation, and quality.

Time to go green!

Making It magazine is a very welcome contribution to UNIDO's efforts to stimulate the debate on development and to make itself known to a wider public. It uses plain terms and does not shun controversy. I have been a regular UNIDO consultant over the past quarter of a century, and I have not seen such a publication. I wish it every success.

In relation to the *Hot Topic* articles around the theme of 'prosperity without growth' in the first issue: with regard to nature, manufacturing has so far basically assumed that it's possible to have a free lunch – it does not return to the biosphere what it takes from it. We have finally understood that this is a problem. The title on the cover of the first issue of *Making It* – 'Time to go green' – should have been followed by an exclamation mark, not a question mark.

● **Paul Hesp, received by email**

Environmental concerns a luxury?

This is a good article ("How I became an environmentalist" – *Making It*, Issue 1), but I wonder how Ms Ellis Lamkins would find it in a much poorer country. California is certainly not a poor place, and I wonder if the environment means something also to people who live on only a few cents every day in Africa and Asia?

● **Marko Simic, received by email**

The *Making It* editor responds: *I think Ellis-Lamkins' article is making the point that health and safety, and the environment, are immediate concerns to workers in countries all over the world. As she writes, parents want to "keep their children and communities healthy, safe,* and *economically viable."*

Hooked

Seeing the first issue of *Making It*, one cannot be but impressed by the quality of the production: first and foremost in terms of content, then the lay-out, colour and design. While the market trend is from print to digital, this print version travels with me! Having started three publishing ventures myself, I know it takes professionals to get the reader hooked on your material, and you certainly did it for me.

● **Prof. Gunter Pauli, founder of Zero Emissions Research and Initiatives, author of *The Blue Economy*, Tokyo, Japan**

Brilliant

Thank you very much for providing me with a copy of your magazine. As a former Austrian representative to the UN, and the current Chairman of the Advisory Board of the European Training Centre for Human Rights and Democracy, I look forward to future issues. With best regards, and all good wishes for this brilliant initiative.

● **Walther Lichem, Vienna, Austria**

After Copenhagen

BIANCA JAGGER, who attended the climate change conference in Copenhagen in December 2009, is strongly critical of the resulting accord, and calls for immediate and concrete steps to avert climate catastrophe.

The experience of participating at the Copenhagen climate change summit (COP15) in December is not one I will easily forget. It was a unique opportunity to set the world on the right path to avoid catastrophic climate change. For two days, most of the world's leaders congregated under one roof for a common purpose. Attended by 120 Heads of State, COP15 was the largest gathering of its kind held outside of the annual UN General Assembly in New York. The two weeks of meetings, extending late into the night, marked the culmination of two years of intensive negotiations. The conference was the focus of unprecedented public and media attention. And yet, the result – the Copenhagen Accord – was a shameful compromise.

Yvo de Boer has recently announced his intention to stand down as head of the United Nations Framework Convention on Climate Change (UNFCCC). In the run-up to COP15 he was unequivocal about the conference being successful only if it delivered significant and immediate action. Sadly, COP15 failed to deliver.

Henry Ford once said that "most people spend more time and energy going around problems than in trying to solve them", and this was true of all too many of the negotiating positions on display at COP15. Those leaders and negotiators must take full responsibility for their actions.

Not legally binding

The failure at Copenhagen has been felt across the world, resulting in grave uncertainty about the ability of world leaders to deliver a comprehensive, legally binding, international climate change treaty. The words "legally binding" were conspicuously absent from the three-page text of the Copenhagen Accord. The Accord is merely "politically binding" for those countries that choose to sign up to it. Furthermore, it does not set emissions reduction targets for either 2020 or 2050, nor does it set a deadline by which the action points should become enforceable.

The Conference of Parties in Copenhagen did not even "adopt" the Accord. They "took note" of it. Rob Fowler, chair of the IUCN Academy of Environmental Law, commented, "The exact status of the so-called 'Copenhagen Accord' ...is unclear... (It) fails to achieve even the status of a 'soft-law' instrument, and thus constitutes the most minimal outcome conceivably possible."

The end of the meeting saw leaders of the United States and the BASIC Group of countries (Brazil, South Africa, India and China) hammering out a last-minute deal in a back room. It was as though the nine months of preparatory talks had never happened, and the Bali Action Plan ➤

• In 2004, BIANCA JAGGER received the Right Livelihood Award, known as the 'Alternative Nobel Prize', for her "long-standing commitment and dedicated campaigning over a wide range of issues of human rights, social justice, and environmental protection". She is the founder and chair of the Bianca Jagger Human Rights Foundation.

➤ adopted in 2007 had never existed. This group found it easier to reach a (non)-agreement behind closed doors on a few basic points of principle, rather than work out a treaty via the formal UNFCCC process. Although the European Union had been the clear global leader in the fight against climate change dating back to COP3 in 1997 when the Kyoto Protocol was adopted, it was not involved in this meeting. UNFCCC participants were presented with a *fait accompli* perceived by many as a 'take-it-or-leave-it' ultimatum.

The Copenhagen Accord did not achieve unanimous consent – several parties raised points of order. As Tuvalu's Prime Minister Apisai Ielemia said, in the UN system "nations large and small are given equal respect; the public announcement of a deal before bringing it before the COP meeting was disrespectful of the process and the UN system." He highlighted major problems with the political agreement, saying it lacked a scientific basis, an international insurance mechanism, and guarantees on the continued existence of the Kyoto Protocol. "We came here expecting an open and transparent process. Unfortunately this is not happening."

What transpired at Copenhagen left developing countries frustrated about their marginalization by the developed world, about their exclusion from policy making, and about the lack of transparency in the way the negotiations were conducted.

350 parts per million

The Copenhagen Accord acknowledges that a rise of more than two degrees Celsius is catastrophic, but it contains no firm commitments to address this impending global crisis. Professor James Hansen, Head of the NASA Goddard Institute for Space Studies is emphatic: "The safe upper limit for atmospheric CO_2 is no more than 350 parts per million (ppm)." Atmospheric levels are currently hovering at around 389ppm.

The UN Programme on Reducing Emissions from Deforestation and Forest Degradation in Developing Countries (REDD) was supposed to have been part of the legally binding treaty. Emissions from deforestation account for approximately 20% of greenhouse gas emissions, and the *Stern Review of the Economics of Climate Change* argues that "curbing deforestation is a highly cost-effective way of reducing greenhouse gas emissions." Planting 10 million square kilometres of natural forests will help stabilize the concentration of CO_2 in the earth's atmosphere at the 350ppm that Professor Hansen prescribes.

In the absence of a legally binding treaty, the implementation of REDD rests on voluntary, country-driven activity. The lowest estimates on the financing of REDD are predicted to be US$22.4 – $37.3 billion from 2010-15 just to support preparatory activities. To date, six developed nations, Australia, France, Japan, Norway, the UK and the US, and have pledged a total of US$3.5 billion to support the implementation of REDD between 2010 and 2012.

The Accord does contain a commitment by developed countries to pay the developing world US$30 billion of "climate aid" over the next three years, with the aim of increasing this amount to US$100 billion a year from 2020. However this offer is not legally binding. There is no mention of which countries will receive financing, in which amounts, on what conditions, or under which mechanisms.

Vapour money

Even concrete financing pledges can be unpredictable, conditional, and selective when implemented, and the finance 'goals' contained in the Accord are anything but concrete. As Professor Hansen puts it, even the money promised to developing countries is "…vapour

money. There's no mechanism for such financing to actually occur, and no expectation that it will."

'Vapour money' is not good enough. We must call for a concrete fiscal plan to incentivize sustainable development. There were no 'goals' when governments were delivering bailouts to the banks during the recent global financial crisis. The amount of money put up by the United States alone to save its banks was US$750 billion.

After the Copenhagen meeting concluded, the French newspaper *Libération* lamented the speed and commitment to saving the planet compared with saving the global financial system: "We must make the bitter observation: when it comes to rescuing the banking system, the dialogue has been far more effective and determined. It is clearly easier to save finance, than it is to save the planet."

The question of how to move forward is a tough one. How do we achieve a contractual commitment, when world leaders, brought together for one purpose, and with all the resources of the COP15, failed?

First vital test

Countries were asked to submit their voluntary proposed domestic greenhouse gas (GHG) reduction pledges in a common document by January 31st, 2010. This was the first vital test of the Accord's relevance. By mid-February, 55 countries had submitted plans to cut GHG emissions. The most significant target to date has been set by Norway, which pledged 30-40% reductions by 2020. Similarly, Liechtenstein, Monaco, Japan, and Iceland have made commitments to reduce GHG emissions in the range of 30%, and the EU has committed to a 20-30% reduction. All of these countries have based their reductions relative to 1990 levels. By contrast, the United States and Canada have framed their pledges in deceptive terms, offering to reduce emissions by 17% relative to 2005 levels, which amount to a mere 3.2% reduction relative to 1990 levels.

> "I am not being alarmist; the situation is alarming. The time for further excuses and postponements, for procrastination or prevarication, has long passed."

India, the world's fifth largest polluter, has pledged to reduce carbon emissions by 20-25% by 2020, relative to 2005 levels, although there is no indication what measures they will take to meet the goal. Similarly, China "will endeavour to reduce its emissions per unit of GDP by 40 to 45% by 2020." China's plan also includes "increasing the share of non-fossil fuels in primary energy consumption to around 15% by 2020, and increasing forest coverage by 40 million hectares and forest stock volume by 1.3 billion cubic meters by 2020 relative to 2005 levels."

Commitment to the Accord and countries' adherence to their own targets will be entirely self-monitored. Some states have indicated their support for the Accord, but have submitted no targets to date. Some have submitted reduction targets, but have not indicated support for the Accord.

Immediate action

The failure of world leaders to broker a global, comprehensive, legally binding treaty was an appalling abdication of responsibility. I am not being alarmist; the situation is alarming. The time for further excuses and postponements, for procrastination or prevarication, has long passed. Now is the time for decision-makers in politics and economics to take concrete steps to avert climate catastrophe; the time for courage and leadership, and for immediate action. Tackling climate change is the over-riding moral imperative of the century. Our future, the fate of future generations, and the future of all other species on this planet hangs in the balance.

Now, more than ever, nations, societies, communities, and individuals are interconnected and interdependent. It is an intellectual illusion to believe that the crises that besiege our world today can be compartmentalised, and that we can address them without revolutionizing our way of life. Climate change will affect everyone, everywhere, in every state, and from every socio-economic group, in hundreds of ways: from the pollution of cities to erosion in rural areas; from contamination of the oceans and rivers to desertification; from mass migration to overcrowded cities, and the security of individuals and states. We must change the way we live, eat, think, do business, and travel, in order to build a society on a solid sustainable foundation.

We cannot do this without cooperation between nations, states, leaders, parties, organizations, and individuals. At this critical juncture in history, we will either stand or fall together. ■

HOT TOPIC

In what is a regular feature, *Making It* invites distinguished contributors to consider one of the controversial issues of the day. The debate continues: what are the pro and cons of biofuels?

Biofuels: a right to food perspective

JEAN ZIEGLER, vice-chairperson of the Advisory Committee of the United Nations Human Rights Council, and former United Nations Special Rapporteur on the Right to Food (2000-2008).

Every five seconds a child below ten years of age dies from hunger. Every four minutes somebody loses his/her eye-sight from a lack of Vitamin A. Every day 25,000 people die from hunger, or immediately-related causes. Over one billion people are gravely, permanently, undernourished. One of the most brutal consequences of malnutrition is noma, a devastating disease that mainly affects children under the age of 12. The disease leaves a terrible hole in the child's face – that is if they survive, given the death rate of 80-90%. It is a shocking reality, and an odious irony that the same Food and Agriculture Organization report which gives the number of the victims of world food insecurity, indicates that global agriculture in its present stage of development could, without problem, nourish twelve billion people, i.e. almost double the current world population.

In recent years, biofuels have been praised as not only a solution to climate change and energy insecurity, but also as an option that can address the food insecurity that ravages parts of the world. However, even before the peak of the food crisis in 2008, when the controversy regarding biofuels reached its climax, concerns were being voiced about the effect that increased biofuel production could have on the right to food.

Environmental impact

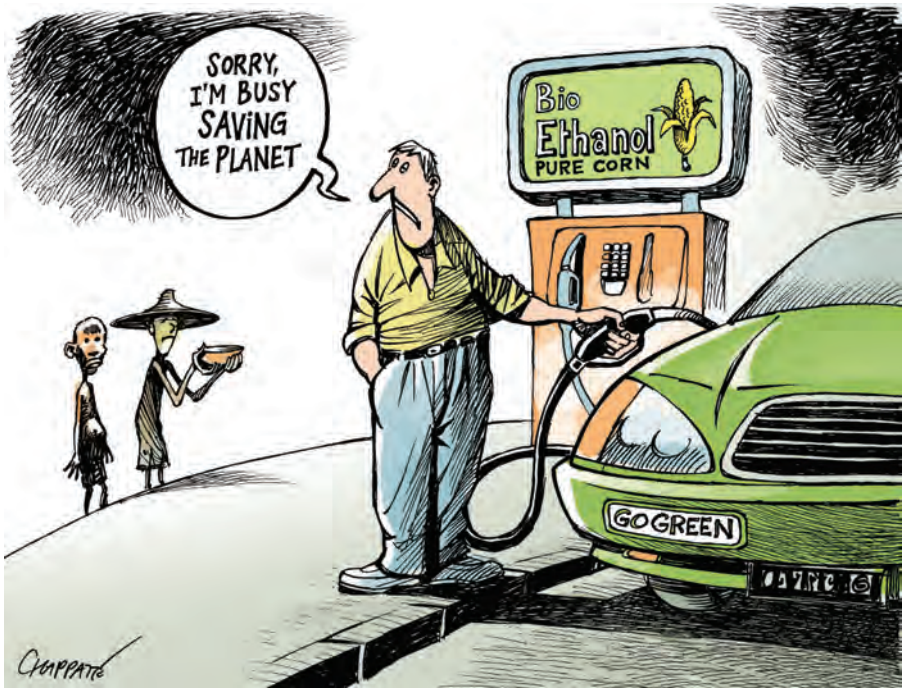
Recent research shows that biofuels, in and by themselves, do not represent an environmental panacea. Whether biofuels are 'green', and offer carbon savings, depends on how they are produced. Sugar cane, for example, is considered to be very effective for the production of bioethanol, and the consumption of the latter is less damaging to the environment than is the use of conventional fuels. Nonetheless, the benefits of bioethanol diminish considerably if carbon-rich tropical forests are being converted into sugar cane plantations, thereby causing vast increases in greenhouse gas emissions. According to one estimate, converting rainforests, peatland, savannas, or grasslands into fields to produce food crop–based biofuels in Brazil, Malaysia, Indonesia, and the United States, creates a "biofuel carbon debt". The process will create up to 420 times more CO_2 than the annual greenhouse gas reductions that these biofuels would provide by replacing fossil fuels. Biofuel production, in such conditions, has the function of an environmental Trojan horse.

On large-scale palm oil plantations in Borneo and Sumatra, and on sugar cane farms in Brazil, water waste and water pollution, overuse of fertilizers, soil erosion, localized air pollution due to chemical spraying, and burning the land after the harvest, are all major problems. The negative environmental effects of biofuel production clearly have an impact on the realization of the right to food for millions of people in the medium and long term, in particular those groups which require accesses to fertile soil and clean water to grow their food.

"A World Bank study estimates that 70-75% of the increase in food commodity prices from 2002 to 2008 was due to biofuels"

Food prices

In the 2007 Special Rapporteur's report to the United Nations General Assembly, I raised the issue of the role biofuels play in the increase in international food prices. Many other expert voices have since made the same link. A World Bank study estimates that 70-75% of the increase in food commodity prices from 2002 to 2008 was due to biofuels, and the related consequences of low grain stocks, large land-use shifts, speculative activity, and export bans. The International Monetary Fund's John Lipsky estimates that the use of food crops, especially



maize, to make bioethanol, is responsible for at least 40% of the price explosion. Subsidies and other fiscal tools aimed at promoting the use of biofuels, in particular in the USA and the European Union, have decisively contributed to a rising demand for sugar, maize, wheat, oilseeds, and palm oil. The incentive to produce crops for biofuels was further augmented by the high price of oil, which made biofuels an even more attractive alternative to fossil fuels. A food/fuel competition could be observed as global wheat and maize stocks declined considerably. The stronger demand for these food commodities as biofuel inputs caused a surge in their prices in world markets, which in turn resulted in higher food prices. The International Food Policy Research Institute projects that the number of people suffering from undernourishment could increase by 16 million for each percentage point increase in the real price of staple food.

Vulnerable groups

Careful attention needs to be paid to the various social impacts that the production of biofuels have on vulnerable groups. The development of biofuel production potentially does have an important role to play in poverty reduction, and hence in realizing the right of everyone to an adequate standard of living, including food security. Nonetheless, experience has shown there are other less welcome social impacts.

The expansion of biofuel production in Latin America, and parts of South-east Asia and Africa, has resulted in violations of land rights and forced evictions – this has been thoroughly documented in many studies and reports by UN agencies. Among those who are particularly affected are indigenous peoples, smallholders, and forest dwellers. Furthermore, when discussing land rights, it is essential to take gender into account. Land tenure systems throughout the world are systematically discriminating against women, very often making land rights dependent on marital status. In this context, the increase in biofuel crop production may come at a high cost to the food security of rural women, who will rarely be able to mount a legal challenge to their displacement by powerful agribusinesses. Along these lines, land concentration – the acquisition of large portions of land usually by foreign corporations or states – may lead, as one analyst warns, to a "process of marginalization or eviction of smallholders to an unprecedented degree, transforming them either into badly-paid workers or swelling the number of urban poor."

Less jobs

Some proponents present biofuels as a real opportunity for employment creation, and thus implicitly beneficial for the food security of those employed. Empirics however offer a more complex – if not a contradictory – reality. In countries where there has been a strong expansion in biofuel production, employment in farming appears to have decreased, and a growing trend for seasonal jobs is observable. The increasing mechanization of the harvest process means that long-term employment predictions must be negative. If we agree that more jobs mean more food security, then less jobs and less stable jobs clearly point to food insecurity and a threat to the realization of the right to food.

An alarming number of reports by NGOs and governmental and intergovernmental agencies are emphasizing the often catastrophic wages and horrific working conditions in palm oil and sugar cane plantations. A system of debt bondage can be observed, which effectively subjects workers to slave-like relations with the owners of the ➤

HOT TOPIC

Bioenergy development in sub-Saharan Africa

STEPHEN KAREKEZI and JOHN KIMANI – AFREPREN/FWD (Energy, Environment, and Development Network for Africa), a non-governmental organization based in Nairobi, Kenya.

Recent high oil and coal prices, as well as an intensified debate about climate change, have led many analysts to suggest that modern bioenergy development could mitigate the negative impacts of unstable fossil fuel prices and continued reliance on inefficient and unhealthy traditional biomass energy options, as well as contribute to reducing greenhouse gas emissions. Consequently, over the last three to four years, many sub-Saharan African countries have started modern bioenergy initiatives, and a number of them have rushed into agreements with international investors for large-scale liquid biofuel development.

Some countries have allowed the clearing of virgin forest land, as well as the conversion of land suitable for food crops into fields for biofuel crops, with probable adverse impacts on forest stocks and food security. In addition, many of the new biofuel programmes are not designed to meet internal demand, but are largely aimed at international export markets, especially the European Union (EU), which has announced ambitious biofuel targets.

The above developments have led some African governments to implement measures that limit the direct production of bioenergy (particularly liquid biofuel) from food crops and/or from former food-producing farmlands. For example, in 2008, the President of the United Republic of Tanzania banned the cultivation of jatropha in a region earmarked for rice production.

The controversy over liquid biofuel development in sub-Saharan Africa has overshadowed less well-known, but successful, biofuel options that deliver significant positive impacts to both rural small-scale farmers and national economies in sub-Saharan African. One of the most significant of these is high pressure cogeneration from the by-products of cane sugar production.

Cogeneration

Cogeneration is the simultaneous production of electricity and process heat from a single dynamic power plant. A cogeneration power plant burns bagasse (the fibrous residue remaining after sugarcane stalks are crushed to extract their juice) to generate steam for process heat, and for driving a turbine to produce electricity. Bagasse-based cogeneration utilizes the waste material which is otherwise a nuisance for sugar refineries – it is a fire hazard, as well as an environmental concern as the decomposition of bagasse releases methane, a more potent greenhouse gas than carbon dioxide.

Bagasse-based cogeneration is not a new technology in the sub-Saharan African sugar industry, but what is novel is the use of highly efficient cogeneration equipment to create an increasingly important source of commercial energy supply. Leading in this process is

➤ plantation and/or other intermediaries. Hunger and the need to feed their families leads individuals to accept appalling working conditions – at times bordering on or equivalent to slavery.

Structural reforms

We have to start assessing biofuels through the prism of the one billion hungry people on the planet today. In other words, governments have to meet their legal responsibility to respect, protect, and fulfil their populations' right to food. Hence, if biofuel production is to be expanded, then structural reforms are necessary to address structural issues. We cannot just pay lip-service to the well-being of current and future generations. There must be land reforms targeted at empowering vulnerable groups, such as landless labourers, forest dwellers, smallholders, indigenous groups, and women. Budgets need to be adjusted to support such programmes, and to reflect the prioritization of vulnerable groups with respect to the right to food. And legislative measures that promote inclusive models – such as Brazil's Pro-Biodiesel programme – should be replicated and pursued as a priority. Such measures would bring biofuels closer to being able to deliver the promised social solution.

Meanwhile, developed countries – partly responsible for the growing demand for biofuels as a result of their subsidy schemes – must acknowledge and address the social and environmental effects of the production, and the expansion of production, of biofuels. After all, as Jean-Jacques Rousseau wrote many years ago, "Between the powerful and the weak, it is liberty that oppresses and it is the law that liberates." The right to food must be upheld by all. ■

Mauritius, where, thanks to the extensive use of bagasse-based cogeneration, the country's sugar industry is self-sufficient in electricity and is able to sell the excess to the national grid. The sugar industry is now contributing over half of the electricity supply on the island. Cogeneration in Mauritius is designed to use bagasse during the cane harvesting season (roughly six months), with coal used to generate the electricity supply for the rest of the year.

Bagasse-based cogeneration development in Mauritius has delivered a number of benefits, including reduced dependence on imported oil, diversification in electricity generation, improved efficiency in the power sector in general, and increased incomes for smallholder sugar farmers. It has also helped sugar factories in Mauritius to weather fluctuations in global sugar prices, including the reduction in the EU's preferential sugar prices to African, Caribbean, and Pacific (ACP) countries. In recent years, the revenue from the sale of excess electricity from cogeneration has enabled Mauritian sugar factories to remain profitable.

Revenue sharing

Perhaps one of the most important achievements is the use of a wide variety of innovative revenue sharing measures. For example, the Mauritian cogeneration industry has worked closely with the government to ensure that substantial monetary benefits from the sale of electricity from cogeneration flow to all key stakeholders of the sugar economy, including the poor, smallholder, sugar farmers. The equitable revenue sharing policies in Mauritius provide a model for ongoing and planned bioenergy projects in other sub-Saharan African countries.

Another important development to note is that, in Mauritius, cogeneration

Sugar processing plant, Mauritius.

Tim Graham/Getty Images

development has resulted neither in an increased competition for land, nor in an increase in food prices – the two most notable negative impacts of large scale bioenergy development. In fact, over time, while increased cogeneration development has led to additional electricity supply, the land area on which sugarcane is cultivated has been declining – implying that increased efficiency in cogeneration has partly led to freeing up land for other uses, including food production.

Several other sub-Saharan African countries have already begun to follow in the footsteps of Mauritius. Ethiopia, Kenya, Malawi, Sudan, Swaziland, Uganda and the United Republic of Tanzania, are taking part in 'Cogen for Africa', an innovative, regional, clean energy initiative funded by the Global Environment Facility and implemented by AFREPREN/FWD.

The potential for sub-Saharan Africa as a whole is significant. Based on current sugar production in sub-Saharan Africa, bagasse-based cogeneration from sugar industries can meet about 5% of the total electricity demand in the region. If biomass waste from other agro-industries and from forestry industries is included, about 10% of electricity in the region could be generated through cogeneration.

Key lesson

The key lesson from the success of bagasse-based cogeneration in Mauritius is the need to prioritize the effective use of existing agricultural wastes for conversion into modern bioenergy fuels. This option has the least adverse impact on the poor, and could provide additional revenue for poor, rural communities. However, it requires establishing effective revenue-sharing mechanisms that ensure that the higher revenues from the exploitation of agricultural wastes are shared in an equitable fashion, and flow to all stakeholders, especially to the low-income farmers. It also requires enacting a legal and regulatory framework that allows for the development of modern agro-waste-based bioenergy, and that provides, among other incentives, access to the power grid and transport fuel market. In some cases, mechanisms for efficient centralization of agricultural wastes would also need to be in place.

Once sub-Saharan African countries have optimized the use of existing agricultural wastes for energy generation, and put in place adequate revenue-sharing, regulatory, and policy frameworks, they can consider the option of large-scale bioenergy plantations, while carefully balancing any associated trade-offs between food security and energy generation. Fortunately, the technical, regulatory, and policy expertise needed to promote an equitable agricultural waste energy industry in many cases also provides the skills needed to develop and nurture a sustainable, dedicated bioenergy plantation sector that does not adversely affect the poor or decrease food security. ■

trends

■ The pace of global growth picked up in February, with a strong manufacturing sector leading the way for services, but firms continued to cut jobs, according to the Global Total Output Index, produced by the financial services firm, JP Morgan. "The recovery was again firmly centred on the manufacturing sector, however, as the rebound in services remained fragile in comparison," said the firm's David Hensley. (JP Morgan)

■ Recent GDP data from across the region suggest that Asian economies are in the vanguard of the global recovery. Thailand, Taiwan Province of China, Hong Kong SAR, and Malaysia all published official data showing that their economies returned to year-on-year growth in the fourth quarter of 2009. However, the Economist Intelligence Unit (EIU) believes it would be a mistake to take this steady stream of good news as proof that a rapid, sustainable recovery is under way in the region. Recent data were boosted by temporary factors, and it also remains unclear to what extent growth is dependent on unsustainable stimulus measures rather than autonomous demand. (EIU)

■ China has become the world's second largest industrial manufacturer, after the United States. These two countries and Japan produce half of the world's manufacturing output. In spite of China's lead in terms of the absolute amount of production, Japan is still the world's most industrialized country, in terms of manufacturing value added per capita, totalling nearly US$9,000 compared to US$700 for China. (UNIDO)

■ The sharp manufacturing recession in Latin America during 2009 will be followed by a strong but uneven recovery, according to a report from the Manufacturers Alliance/MAPI. The report focuses on Latin America's three largest economies – Brazil, Argentina, and Mexico – as these countries are responsible for more than 80% of the manufacturing output in the region. MAPI forecasts that overall manufacturing output in Latin America will decline 7.9% in 2009, but should rebound in 2010 with 5% growth. (MAPI)

■ Spending on clean energy held up better than expected during the financial crisis and resulting recession in 2009, but a considerable gap still exists between current levels of investment and what is needed to begin reducing the world's carbon

BUSINESS MATTERS

First osmosis power plant opens

In November 2009, the Norwegian company, Statkraft, opened a prototype power plant that generates electricity using the natural process that keeps plants standing upright and the cells of animal bodies swollen, rigid, and hydrated. Osmosis occurs when two solutions of different concentrations meet at a semi-permeable membrane.

At the osmotic power plant at Tofte, near Oslo, the two solutions used are sea and fresh water, siphoned from near the point where they meet at the mouth of a fjord. The sea and fresh water are guided into separate chambers, divided by an artificial membrane. The salt molecules in the sea water pull the fresh water through the membrane, increasing the pressure on the sea water side. This pressure can be used to turn a power-generating turbine.

The prototype plant at Tofte has a limited production capacity, and is intended primarily for testing and development purposes. Many of the world's major cities are on river estuaries where sea and fresh water are easily available, and Statkraft estimates the total global potential of osmotic power to be around 1700 terawatt-hours per year – about 10% of the world's current electricity consumption. The company hopes that a commercial osmotic power plant will be constructed within a few years' time.

Unlike wind and solar power, osmotic power can provide a continuous source of energy, although seasonal river-level changes do cause some fluctuations. Critics also say that scaling up the technology could prove difficult because fundamental questions, such as the effect of silt and river bacteria on the membranes' performance over time, have not been resolved.

Workers venting a geothermal pipeline.

The world's ten leading geothermal cities

Copenhagen, Denmark: Having set a target of zero carbon emissions by 2025, the city could meet 50% of its heating needs by using its geothermal resources.

Larderello, Italy: Boasts the very first geothermal power plant, which opened at the beginning of the 20th century.

Reykjavik, Iceland: Abundant geothermal resources provide heat for approximately 87% of Iceland's buildings.

Reno, Nevada, USA: City and business leaders are marketing the city as a geothermal centre for industrial activities, corporate offices, and research facilities.

Perth, Australia: Aims to be the very first geothermally-cooled city, with commercial geothermal-powered air-conditioning units.

emissions. A recent World Economic Forum (WEF) report found that investment in 2009 was remarkably resilient at US$145 billion, down only 6% from US$155 billion in 2008. The decline would have probably been much bigger if it weren't for the billions that governments around the globe poured into economic stimulus programmes. However, according to the WEF, if the increase in global average temperatures is to be restricted to 2°C, low-carbon energy infrastructure will require global annual investment of around US$500 billion per annum. While the next few years are likely to see record investment activities, a significant financing gap of US$350 billion still exists. (WEF)

PHOTO: MAYUMI TERAO/ISTOCK

Xianyang, China: Recently designated "China's Official Geothermal City," Xianyang is helping China meet its goal of 16% of energy use from renewables by 2020.
Madrid, Spain: Six renewable energy projects are underway, one of which is a 8-MW geothermal district heating project.
Masdar City, Abu Dhabi: The city's goal is to function 100% on renewable energy, half of it from geothermal resources.
Klamath Falls, Oregon, USA: Geothermal energy has been used to heat buildings since the turn of the 20th century, and is now used for a variety of purposes including heating homes, schools, businesses, swimming pools, and for snow-melt systems for sidewalks and roads.
Boise, Idaho, USA: The Boise Public Works Department has the largest, direct use, geothermal system in the United States.

Source: The Geothermal Energy Association, a trade association composed of US companies which support the expanded use of geothermal energy.

events

- **B4E, the Business for Environment Global Summit** April 21-23, Seoul, Republic of Korea. www.b4esummit.com
- **World Geothermal Congress and Exhibition 2010** April 25-30, Bali, Indonesia. www.wgc2010.org/
- **Ninth Responsible Business Summit** May 4-5, London, UK. One of the largest Corporate Social Responsibility conferences in Europe. www.ethicalcorp.com/rbs
- **Energy Efficiency Global Forum and Exposition 2010** May 10-12, Washington DC, USA. http://eeglobalforum.org/
- **Bioenergy Markets Africa: Expanding sustainable bioenergy production** May 11-13, Maputo, Mozambique. www.greenpower conferences.co.uk
- **Third Mediterranean Sustainable Energy Summit 2010** May 18-19, Athens, Greece. www.ftbusinessevents.com/ medsustainableenergy
- **The UN Global Compact Leaders Summit 2010**, June 24-25, New York, USA. www.leaderssummit2010.org/
- **Green Investments Summit** July 12-15, Jakarta, Indonesia. www.alleventsgroup.com/ gisindo2010/
- **Fourth International Solar Cities World Congress** September 16-19, Dezhou, China. www.chinasolarcity.cn
- **World Renewable Energy Congress XI and Exhibition 2010** September 25-30, Abu Dhabi, United Arab Emirates. www.wrenuk.co.uk

New Delhi hydrogen three-wheeler project

A fleet of 15 hydrogen-fuelled three-wheeler vehicles is about to begin service in New Delhi, India. The auto-rickshaws will carry passengers from the Pragati Maidan metro station to a nearby exhibition centre.

The Hy-Alfa vehicles, built by the Indian car manufacturer, Mahindra and Mahindra, are powered by dedicated hydrogen-fuelled 400cc internal combustion engines, and will use compressed natural gas-style fuel storage tanks. The hydrogen will be supplied by one of the largest merchant hydrogen suppliers in the world, Air Products.

The project, run by the Istanbul-based International Centre for Hydrogen Energy Technologies (ICHET), together with a consortium of companies, has great potential for replication across India. Hydrogen is a by-product of India's chlor-alkali industry that at the moment is burnt (flared) because there is no use for it.

Dr. Mathew Abraham, general manager at the Mahindra and Mahindra Research and Development Centre, said, "The Hy-Alfa is the first vehicle of its kind in the world. It runs on nothing but compressed hydrogen gas, and is engineered to run with absolutely zero emissions, which makes it a pleasure to drive on congested city roads. Hydrogen is, in fact, the technology and fuel of tomorrow, and is the long term solution to pollution, energy security, and CO_2 emission-related concerns."

PRAKASH SINGH/AFP/GETTY IMAGES

Hydrogen fuel is expected to be a solution to the problems created by the high nitrogen oxide emissions from the compressed natural gas (CNG)-fuelled three-wheelers currently in use in Indian cities.

Photo: KieselUndStein/istock

Renewable energy options in developing countries

With global energy consumption set to surge, greenhouse gas emissions increasing, and stocks of fossil fuels dwindling, **JOSÉ GOLDEMBERG** and **OSWALDO LUCON** look at the alternatives.

In 2009 the world energy consumption was 11.3 billion tonnes of oil equivalent (toe). Energy consumption in industrialized countries has basically been stable in the last 10 years, but in the rest of the world it has been growing at approximately 5% per year. At this rate and based on present technologies, the world's annual energy consumption could reach 20 billion toe by the year 2020. The consequences of such growth – approximately 80% of it originating from fossil fuels – could be disastrous for three reasons:

- the depletion of fossil fuel resources;
- geopolitical problems caused by access to such fuels, and
- environmental problems, notably global warming.

Developing countries are witnessing a substantial growth in their greenhouse gas emissions, mostly due to rapid industrialization and transport growth, but also due to the unsustainable use of fuelwood and subsequent deforestation.

Solving these problems implies tackling their causes: a huge effort that encompasses basically complementary actions and policies in terms of energy efficiency (or energy conservation) in order to obtain an equivalent well-being by using fewer natural resources; renewable energies, which can be used instead of fossil fuels; and new technological advances to improve energy efficiency and utilize renewable energy.

Energy efficiency extends the life of finite resources, reduces environmental impacts, secures supplies for the long-term, and frequently offers attractive economic returns. However, increasing access to energy services really depends on an enhanced supply. Fortunately, this can be safely achieved by using a wide variety of renewable sources, some of which, such as hydropower and biomass, are already well-developed. Most developing countries are located in tropical areas where the existence of rivers and rain-fed, arable land provide the conditions for these energy sectors to flourish. While competition with food production and multiple water uses are important issues, more often than not the problems may be overestimated, and can be dealt with through appropriate logistical and land-use planning. ➤

JOSÉ GOLDEMBERG is Professor at the Institute of Electrotechnics and Energy, University of São Paulo, Brazil.
OSWALDO LUCON is a technical adviser on energy for the São Paulo State Environment Secretariat, Brazil.

Attractive biomass options already exist. Sugar cane ethanol production (and associated bagasse cogeneration) in Brazil, geothermal energy in the Philippines, agricultural waste-to energy in India, thermal solar energy in China, and improved wood-fuel cook stoves in some African countries are some successful examples.

There are also newer renewable technologies under development, with biomass having good prospects for rapid technological advances, particularly in relation to improved use of agricultural wastes, municipal solid waste incineration, and the production of several types of biodiesel. Several bioenergy transformation routes using diverse types of biomass are possible, from simple boilers for domestic heating to integrated energy farms.

Although still in the research phase, second generation biofuels, and advanced solar, marine and geothermal applications, may become economically viable in certain circumstances.

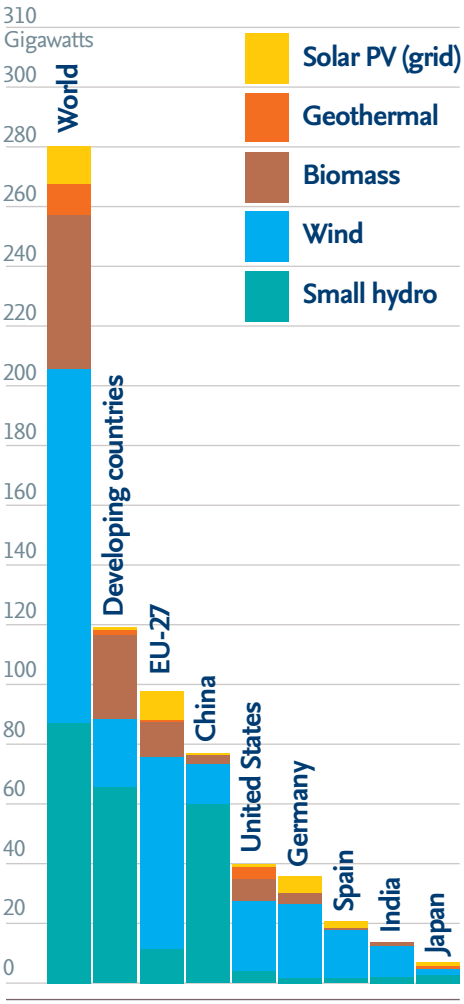
Wind and solar

Wind power production technology has become highly sophisticated, with important developments in the areas of control, aerodynamics, and materials. Large systems can have hundreds of high-tech, large generators, each with a generation capacity of 5MW and blades spanning more than 80 metres. Wind power machinery costs have recently dropped significantly, mainly because manufacturers in developed countries have benefited from government support policies. As a consequence, the price of wind turbines for customers in developing countries is also coming down.

Solar thermal energy has huge potential in the developing world, but the relatively high start-up costs, and the subsidies provided to conventional fossil-based sources, are barriers to a more rapid deployment. Simple applications such as plastic solar collectors or cook stoves are initial steps frequently used in demonstration projects, especially in poorer countries. However, their take up has often been very limited, and the user regularly reverts to traditional sources of energy. More positively, China has moved steps ahead by subsidizing the use of solar panels for water heating, while in Brazil, the use of solar panels may negate the need for large investments in the additional power production now required to supply the electricity used at peak times. For example, solar power can be used to produce electricity for water heaters and other small appliances.

For small islands, mountain villages and other more remote communities, solar photovoltaic systems offer good prospects. The technology is ideal for small applications and certain niches, as the power produced is enough to refrigerate vaccines and medicines; preserve food and fishing products; make small and micro businesses viable; light houses, schools and medical centres; extract and pump water from wells; and power communication and entertainment systems. Solar may be one of the main technologies for future integration of decentralized energy systems.

Renewable power capacities, 2008 (REN21, Renewables Global Status Report: 2009 Update)



Biofuels

So far, bioethanol and biodiesel are the best biofuel options, followed in some cases by vegetable oils. The Brazilian sugarcane ethanol programme produces fuel that is cost competitive in a free market, and has a positive energy balance of up to ten outputs to one unit of input. For these reasons alone, it could be promoted as a fuel alternative in other countries in the world. Concerns about the environmental and social impacts of biofuels are being addressed in a responsible manner – a response driven by the threat that technical trade barriers will be imposed as a result of consumer pressure. Meanwhile, there are high expectations for second-generation biofuels, especially cellulosic ethanol (produced from wood, grasses, or the non-edible parts of plants), which could promote a real clean energy revolution when achieving competitive costs.

Decoupling

The energy crisis of the late 1970s led to an energy revolution when new technologies that became commercially available at that time made it possible to provide energy services with a smaller energy input than would have been possible with the technologies then in widespread use. This meant there could be a decoupling between GDP growth and energy growth, and this did in fact take place in the industrialized countries in the 1970s and 1980s. Using energy more efficiently, and switching from fossil fuels to renewable energy sources, meant that economic growth, as measured by GDP growth rates, could continue, even though the growth in energy consumption slowed. For example, the energy consumption of the European Union is today 50% lower than it would have been if the measures taken in response to the 1973 oil crisis had not been implemented. Another more recent example is provided by China, which since 1990 has enacted bold energy efficiency measures. While GDP has increased almost nine-fold, in the same period, carbon emissions are only two and half times greater.

In this context, developing countries can today take advantage of a great opportunity. Rather than replicating the economic development process of industrialized nations, which went through a phase that was dirty and wasteful, and created an enormous legacy of environmental pollution, developing countries can leapfrog ahead by incorporating currently available, modern, and efficient technologies in the early stages of their development process.

The use of renewable energy resources is progressing rapidly, and will probably represent a very significant contribution to energy consumption in the next few decades. A combination of energy efficiency, and renewable and emerging new technologies using biomass, wind, and solar energies, could sustain development for the majority of the human population over the course of the 21st century. ■

Photo: Keith Dannemiller/Corbis

The next industrial revolution

Female worker engaged in zinc and lead extraction operations at the Madero mine, Zacatecas, Mexico.

Drawing on the new International Energy Agency publication, *Energy Technology Transitions for Industry: Strategies for the Next Industrial Revolution*, **NOBUO TANAKA** looks at the technologies for reducing industrial CO_2 emissions and the policies that are needed to ensure their widespread use.

Nearly one-third of global energy demand and almost 40% of worldwide CO_2 emissions are attributable to industrial activities. The bulk of these CO_2 emissions are related to the large primary materials industries, such as chemicals and petrochemicals, iron and steel, cement, pulp and paper, and aluminium. If we are to successfully combat climate change, industry will need to transform the way it uses energy, and radically reduce its CO_2 emissions.

Over recent decades, industrial energy efficiency has improved, and CO_2 intensity has declined substantially in many sectors. However, this progress has been more than offset by growing industrial production worldwide. As a result, total industrial energy consumption and CO_2 emissions have continued to rise. Over the next 40 years, demand for industrial materials in most sectors is expected to double or triple. Projections of future energy use and emissions based on current technologies show that without decisive action, these trends will continue. This path is not sustainable.

Making substantial cuts in industrial CO_2 emissions will require the widespread adoption of current best available technologies (BAT), and the development and deployment of a range of new technologies. This technology transition is urgent; industrial emissions must peak in the coming decade if the worst impacts of climate change are to be avoided. Industry and governments will need to work together to research, develop, demonstrate, and deploy the promising new technologies that have already been identified, and also to find and advance new processes that will allow for the CO_2-free production of industrial materials in the longer term.

NOBUO TANAKA is the Executive Director of the International Energy Agency (IEA)

Furthermore, such emissions reductions will only be possible if all the regions of the world contribute. Action in OECD countries alone, which represent 33% of current global industrial CO_2 emissions, will not be sufficient to make the necessary reductions. Industrial production will continue to grow most strongly in non-OECD countries so that by 2050, if no further action is taken, they will account for 80% of global industrial CO_2 emissions.

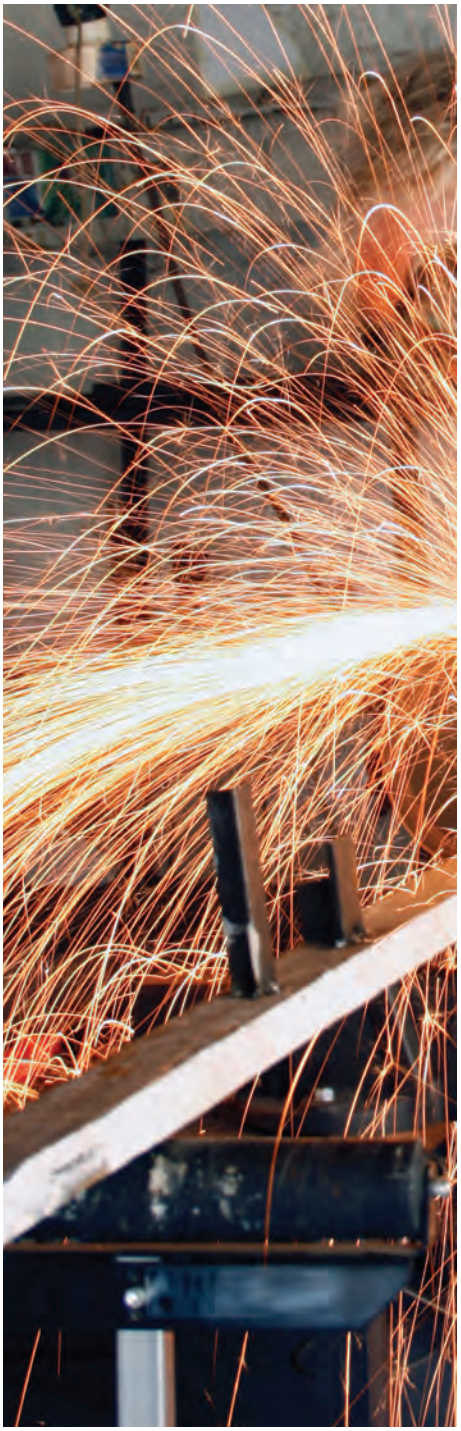
Industry exhibits a number of characteristics that set it apart from other end-use sectors, and these need to be taken into account when designing energy and climate policies for the sector. First, while significant energy efficiency potentials remain, they are smaller than in the building or transport sectors. ➤

Policies should therefore promote realistic levels of energy efficiency improvement and CO_2 reduction, and ensure, where possible, flexibility in the way these can be achieved. Secondly, many industries compete in global or regional markets, and so the introduction of policies that impose a cost on CO_2 emissions in some regions, but not others, risks damaging competitiveness and may lead to carbon leakage – in other words, industries relocating to regions with lesser carbon restrictions. While there is little, if any, evidence of such effects to date, this may become a significant problem if CO_2 prices rise substantially in the future. Thirdly, many industrial sectors have the knowledge, technology access, and financing possibilities to reduce their own CO_2 emissions if governments provide a stable policy framework that will create clear, predictable, long-term economic incentives for the use of new efficient and low-carbon technologies.

The implementation of current BAT could reduce industrial energy use by between 20% and 30%, and should be a priority in the short term. But this will be nowhere near enough to achieve absolute reductions in CO_2 emission levels, as production is expected to double or triple in many sectors. Continued improvements in energy efficiency offer the largest and least expensive way of achieving CO_2 savings over the period to 2050. Energy efficiency gains will need to increase to 1.3% per year, a rate that will require the development of new energy-efficient technologies. Many new technologies which can support such an outcome, for example smelt reduction, new separation membranes, black liquor and biomass gasification, and advanced cogeneration, are currently being developed, demonstrated, and adopted by industry.

New low-carbon fuels and technologies will also be needed, with a smaller but important contribution from increased recycling and energy recovery. The use of biomass and electricity as CO_2-free energy carriers will be significant. While the technologies required are often sector-specific, the development and deployment of carbon capture and storage (CCS) will be critical for achieving deep emissions reductions, particularly in the iron and steel, and cement sectors.

Additional research, development, and demonstration are needed to develop breakthrough process technologies that allow for the CO_2-free production of materials, and to advance understanding of system approaches, such as the optimization of life-cycles through recycling and using more efficient materials. These longer-term options will be needed in the second half of this century to ensure sustainability of industrial processes to the end of the century, and beyond.



Technology development is fraught with uncertainties. Some of the technologies identified may never come to fruition, but future research may also deliver new technologies or breakthroughs that are not currently foreseen. A portfolio approach can help to deal with this uncertainty.

CO_2 emissions reductions will be needed across the whole of industry, but action is particularly crucial in the five most energy-intensive sectors: iron and steel, cement, chemicals and petrochemicals, pulp and paper, and aluminium. Together, these sectors currently account for 75% of total direct CO_2 emissions from industry, and the application of current BAT, together with the development and deployment of promising new technologies, will be required in order to significantly reduce energy use and CO_2 emissions.

Iron and steel

The worldwide use of current BAT could deliver energy savings of about 20% of today's consumption. Given the limited efficiency potential inherent in existing technologies, new technologies such as smelt reduction will be needed. Fuel switching can also help to reduce emissions. CCS is an important option that would allow the sector to achieve deep reductions in emissions in the future. Large-scale CO_2 capture pilot projects at iron and steel plants must be urgently developed in order to better understand the cost and performance of different CO_2 capture methods.

Cement

Reducing CO_2 emissions in this sector is very challenging owing to high process emissions related to the production of clinker, the main component in cement. Improving energy efficiency at existing plants, investing in BAT for new plants, and increasing the use of alternative fuels and clinker substitutes could reduce current energy use by 21%, but this will not be enough to achieve net emissions reductions in the future. New technologies should be developed and implemented, particularly in the application of CCS to cement production.

Chemicals and petrochemicals

The full application of best practice technology in chemical processes could achieve energy savings of approximately 15%. Additional measures such as process intensification and process integration, the greater use of combined heat and power, and life-cycle optimization by recycling and energy recovery from post-consumer plastic waste, could save more final energy. However, there are important barriers which constrain the exploitation of this theoretical potential. To achieve future CO_2 emissions reductions in the sector, a range of new technologies must be developed.

Pulp and paper

Significant potential exists in many countries to increase energy efficiency and reduce CO_2 emissions in this sector. A transition to current BAT could save up to 25% of energy used

today. Reducing emissions in the sector will require additional improvements in efficiency, fuel switching to biomass, and the increased use of combined heat and power. Promising new technologies such as black liquor gasification, lignin removal, biomass gasification, and CCS, will also be needed to achieve significant emissions reductions.

Aluminium

Most of the energy consumed in the aluminium industry is in the form of electricity used for smelting. The impact of implementing BAT is limited, offering the potential to reduce energy use by up to 12% compared with current levels. Important options include reducing heat losses in refineries, improving process controls, and reducing heat losses and the electricity used in smelters. In the longer-term, moving towards the use of zero-carbon electricity in smelters is the single largest opportunity for long-term CO_2 emissions reduction.

***

The world's industry emissions in 2050 can only be reduced by 21% compared to today's levels (industry's contribution to a halving of global emissions) if all regions significantly reduce their CO_2 intensity. In a 'business-as-usual' scenario, where there is no change in policy, emissions are expected to continue rising in all regions to 2050. China's emissions will continue to rise rapidly in the next twenty years, but then will rise only moderately as the country's consumption of the most CO_2-intensive products, such as cement and iron and steel, begins to level off after 2030. As domestic consumption feeds demand, India's industrial CO_2 emissions will grow the most of all countries. In other developing countries in Asia, Africa, and the Middle East, current levels of industrial development are significantly below current levels, and industrial production is expected to grow at the fastest rates. These three regions will account for 24% of total global industry emissions by 2050, significantly surpassing total OECD industry emissions. If global industry is to achieve significant reductions in emissions, effort will be required in these regions to reduce the CO_2 intensity of industrial production, and they will need support for technology transfer and deployment.

Bringing about the technology transition needed to reduce emissions in industry will not be easy. It will require both a step change in policy implementation by governments, and unprecedented investment in best practices and new technologies by industry. Engaging developing countries and their industries in this transition will also be vital, since most of the future growth in industrial production, and therefore CO_2 emissions, will happen in countries outside of the OECD region.

Photo: Barnaby Chandler/istock

"Industry and governments will need to work together to research, develop, demonstrate and deploy the promising new technologies that have already been identified"

Given these considerations, a global system of emissions trading may eventually be a crucial policy instrument for promoting CO_2 abatement in industry. However, a worldwide carbon market is unlikely to emerge immediately and so, in the short to medium term, international agreements covering some of the main energy-intensive sectors might be a practical first step in stimulating the deployment of new technologies, while addressing concerns about competitiveness and carbon leakage. Meanwhile, national energy efficiency and CO_2 policies, involving standards, incentives and regulatory reform (including the removal of energy price subsidies), which address specific sectors or particular barriers, will continue to be necessary. Gaining public acceptance for certain new technologies may also be important to their widespread deployment.

To complement policies that generate market pull, many new technologies will need government support while in the research, development, and demonstration (RD&D) phases before they become commercially viable. There is an urgent need for a major acceleration of RD&D in breakthrough technologies that have the potential to change industrial energy use or reduce greenhouse gas emissions. Support for demonstration projects will be particularly important. This will require greater international collaboration, and will need to include mechanisms to facilitate the transfer and deployment of low-carbon technologies in developing countries.

A number of regional and international industrial associations are already examining how their members might rise to the challenge posed by climate change. I welcome these efforts and reaffirm that the International Energy Agency (IEA) is looking to play its part. For instance, the IEA has been asked by the G8 to develop roadmaps for the most important low-carbon technologies. As part of this activity we have recently completed, together with the Cement Sustainability Initiative of the World Business Council for Sustainable Development, a cement sector roadmap. We would welcome the opportunity to replicate this activity with other sectors and to help show the way to the next industrial revolution. Industrial production growth must be developed in a sustainable way. Countries and industry should make green growth their priority. ■

ENERGY

Energy access is widely regarded as the 'missing' Millenium Development Goal. It will create the opportunities for people across the world to step out of the poverty trap. **KANDEH K. YUMKELLA** and **LEENA SRIVASTAVA** argue that now is the time to prioritize energy access in order to promote economic development.

FOR ALL

Photo: Sven Torfinn/Panos

Bamako, Mali: An adult literacy evening class illuminated by a bulb powered by a car battery.

Large parts of humanity – billions of people – live without access to modern energy services. These are fundamental services that most of us take for granted, like light, fuel for heating and cooking, and mechanical power. Despite the efforts of many committed people, working on excellent programmes, about 1.5 billion people still don't have access to electricity, and around 2.5 billion people rely on traditional biomass as their primary source of energy – a clearly unsustainable position. It is widely accepted that this lack of access to affordable, reliable, energy services is a fundamental hindrance to human, social, and economic development – and is thus a major impediment to achieving the Millennium Development Goals (MDGs). The issue is also a stark illustration of the deep inequity that exists between the rich and poor. Roughly, the poorer three-quarters of the world's population use only 10% of the world's energy. The rich countries aim for a secure, environmentally acceptable, and affordable energy supply – but what about the billions without access?

The issue is not abstract for either of us. We have both witnessed it in our own countries: Sierra Leone and India. A few success stories do exist – countries such as China have improved the access for their citizens substantially in the last decades, but all across sub-Saharan Africa, and in parts of Asia, people are living without basic energy services. The demand for energy in these regions is expected to grow dramatically, with increases in population and improvements in living standards adding to the scale of the challenges. It is

"Energy access must move up the political and development agendas to become a central priority"

KANDEH K. YUMKELLA is the Director-General of the United Nations Industrial Development Organization. Since August 2007, he has served as Chair of UN-Energy, the inter-agency mechanism to coordinate energy-related issues within the UN system. He is also Chair of UN Secretary-General Ban Ki-moon's Advisory Group on Energy and Climate Change consisting of business leaders and experts.

LEENA SRIVASTAVA is the Executive Director of The Energy and Resources Institute (TERI), an independent, not-for-profit, research institution, based in New Delhi, and working in the areas of energy, environment, and sustainable development. She was the lead author for the Third Assessment Report of the Intergovernmental Panel on Climate Change.

really quite stunning to realize that, if 'business as usual' conditions are maintained, over the next decades the total number of people without access to modern energy services will not decrease. Current efforts are insufficient in scale and scope, and attempting to address the issue in the same way that we have in the past is clearly not remotely adequate.

Energy for development

Energy services have an effect on productivity, health, education, safe water, and communication services. Therefore, it is no surprise that access to energy has a strong correlation to social and economic development indices (e.g. the Human Development Index, life expectancy at birth, infant mortality rate, maternal mortality, and GDP per capita).

The UN system has been working on energy access issues for decades. In 2005, UN-Energy, the UN's inter-agency mechanism for energy issues, considered the link between energy and the MDGs, and reminded us that:

- Energy services, such as lighting, heating, cooking, motive power, mechanical power, transport and telecommunications, are essential for socio-economic development, since they yield social benefits, and support income and employment generation.
- Reforms to the energy sector should protect the poor, especially the 1.1 billion people who live on less than US$1 per day, and should take gender inequalities into account by recognizing that the majority of the poor are women.

In 2007, the UNDP reviewed a large number of national MDG reports to assess the extent to which energy issues were included. The findings revealed the need for a more coherent and focused approach to energy in the 2010 MDG review process. For example:

- About a quarter of the reports offered considerable coverage of energy issues, including a more nuanced analysis of the country's energy situation, but about one-third of the reports only had a moderate amount of information on ➤

➤ energy (i.e. a paragraph or more, offering some statistics or baseline energy information), and some 42% of reports contained little or no mention of energy at all.

● The most popular energy topics discussed were energy efficiency and energy use as a contributor to air pollution. The reports from African countries, however, most often discussed energy in the context of wood-fuel use and deforestation issues.

The obstacles to energy access are well known. These barriers, while complex, can be overcome, and international cooperation can help this process. What cannot be overstressed is that there are no fundamental technical barriers: we know how to build power systems, we know how to design good cooking stoves, and we know how to meet energy demand efficiently. What is required is a political prioritization. Energy access must move up the political and development agendas to become a central priority.

Equally important is a clear understanding that local communities must be deeply involved in the planning, execution, and end-use of energy services. Energy access interventions must be guided by an awareness of local communities' unique situations and needs.

Getting business on board

The bulk of the efforts to improve energy access have, naturally, focused on parts of Asia and sub-Saharan Africa. There are decades of experience with many poorly designed or implemented programmes, but some successful models have emerged, including both public efforts such as those carried out by the international financial institutions and UN agencies, and the delivery of related funding and services by NGOs and private sector companies, such as India's Solar Electric Light Company.

Many global campaigns are also starting to address the issue. One of these is the *Lighting a Billion Lives* campaign which aims to bring light into the lives of one billion rural people by replacing kerosene and paraffin lanterns with solar lanterns. This campaign, which was launched in February 2008, illustrates the opportunities to mobilize industry participation in development impacts. About 15 months after the campaign was inaugurated, and with nearly 100 villages across India involved, big industry recognized the market opportunity. Leading manufacturers of components and assemblers of the final product – solar lanterns – came forward to partner The Energy and Resources Institute (TERI) in this initiative. The key drivers for this partnership were:

● The resolve to implement the initiative, and the confidence thereby generated.

● The offsetting of the perceived small and dispersed scale of the effort by the promise of large volume.

● The knowledge generated from the constantly evolving, context-specific business models (fee-for-service with capital costs progressively moving from grant, to part-equity, to loan financing, and leveraging other development programmes) and the widening partnership base (industry, donors, governments, financial institutions, universities, mass media etc.).

● The creation of a rural entrepreneurship base founded on this initiative but with a capacity to evolve into related development businesses.

Other large ongoing campaigns include:

● *Lighting Africa*, a World Bank Group initiative aiming to provide up to 250 million people in sub-Saharan Africa with access to non-fossil fuel-based, low cost, safe, and reliable lighting products, with associated basic energy services, by the year 2030.

● *Energy Poverty Action*, a joint initiative of the World Business

FIGURE 1:
Countries with energy access targets (UNDP, 2009)

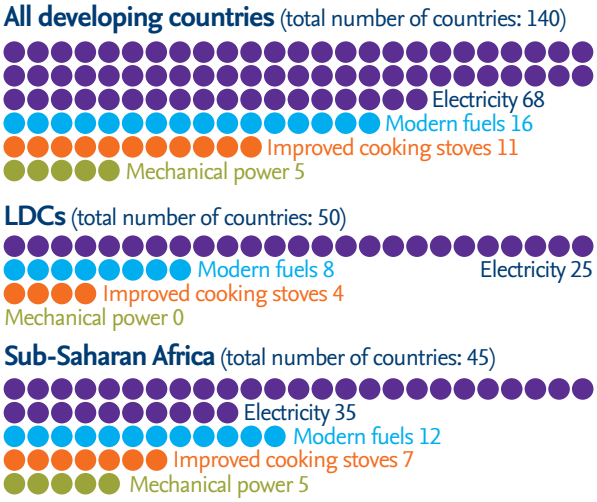
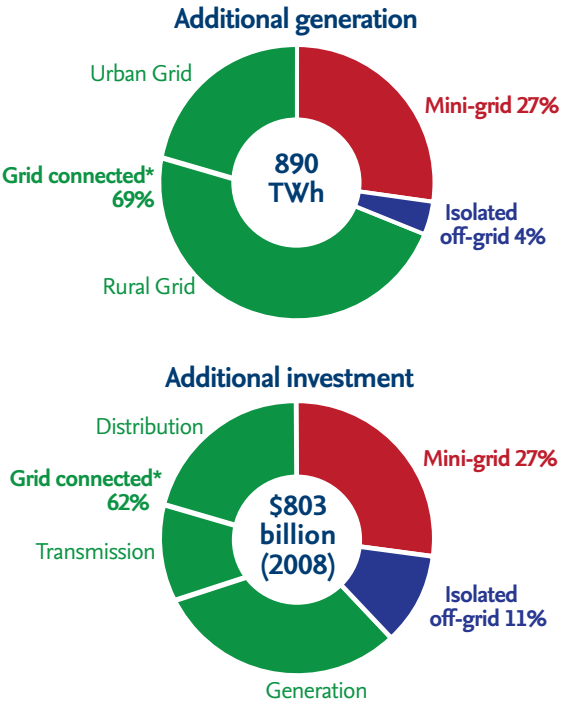
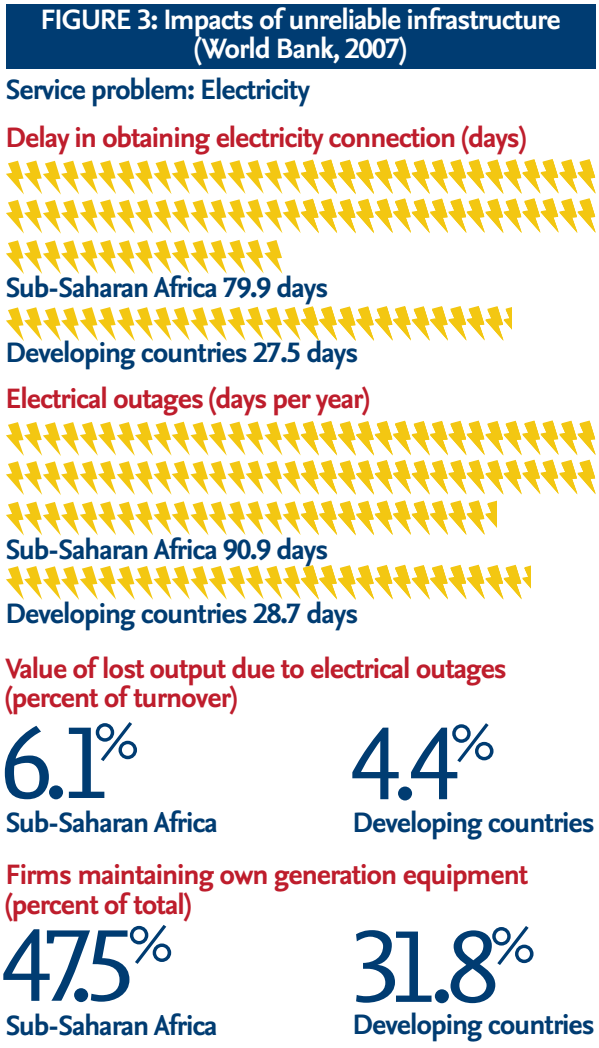


FIGURE 2:
Investment requirements to 2030 (IEA, 2009)



* Covers generation, transmission, and distribution for both urban and rural grids

FIGURE 3: Impacts of unreliable infrastructure (World Bank, 2007)



Council for Sustainable Development, the World Energy Council, and the World Economic Forum, aiming to demonstrate business-oriented approaches to modern energy provision at community level which are scaleable, replicable, and commercially and environmentally sustainable.

All of these programmes and campaigns will be better implemented if they are grounded in national policies. Those of us working in international organizations need to support national and regional plans and targets. A recent UNDP paper showed that 68 developing countries have electricity targets (Fig. 1), but in order to meet their targets, these countries will require financial support, capacity development, and better regulation and governance structures.

Money matters

The financial implications of universal energy access are huge, and are comprehensively described in the *World Energy Outlook 2009*, published by the International Energy Agency (IEA). The agency looked at a specific universal energy (electricity) access scenario, and the results showed the need for around US$800 billion over the next two decades (Fig. 2). This figure equates to approximately US$40 billion per year over the period – or around 10% of the total investment in the energy sector each year (according to the IEA reference case). It is roughly in line with experiences from Brazil and South Africa that show that about US$2,000 per household is required. While the bulk of the investment in the IEA scenario goes to grid extensions and grid-tied generation, there is a large role for mini-grids (but not mini-financing!) to serve rural populations.

Overall, the existing macro investment calculations cannot reflect the varied and complex investment requirements and environments. In addition, calculating this figure for electricity is a simpler task than doing so for modern fuels (where there are more substitutability issues, cultural and gender issues, etc.). It bears repeating that this issue will require a large suite of financial mechanisms with a focus on addressing a large array of real and perceived risks.

More than just a light

It is essential to remember that providing reliable and secure energy services to those currently without access is not simply about supplying electricity for lighting or improved cooking stoves. To promote economic development and growth, these energy services need to be put to productive uses that positively affect livelihoods, providing power for industry, improving health care and education, and improving transportation. Furthermore, simply supplying the power source will be insufficient if the necessary equipment and appliances are not deployed. Finally, sustainable energy access will require a model that generates local revenues to pay for modern energy services. Electricity not only provides lighting that permits children to study at night, it allows for the refrigeration of perishable agricultural products, and increased value added through the first steps of industrialization.

Experience has repeatedly shown that subsidy schemes cannot be sustained over the long-term. The ultimate goal must be a market-based approach. However, many energy markets are distorted, and political intervention is common. For example, in India, certain states provide free electricity to farmers. This has resulted in huge government deficits, wastage of scarce groundwater resources on inefficient irrigation, and a lack of funding for enhanced electrification, upgrading of power plants, and improvement of transmission and electricity grids elsewhere. Energy subsidies are clearly not the optimal way to solve access problems.

It is clear that access to energy is about more than quantity. Quality is essential. This is true for both electricity and fuels. As an example, high costs and unreliable electricity service constrain economic activity in many countries, and constitute a severe obstacle to business operation and growth. The World Bank indicators (Fig. 3) show the scale of the issue in terms of connection times, outages, the value of lost output, and the need for onsite generation.

High transaction and unit investment costs constrain service provision in rural areas because of low demand and dispersed populations. Utilities that are commercially and financially weak cannot drive access expansion of the network, but nevertheless occupy a monopoly position in many countries. South Africa is a typical case, where very low electricity prices have resulted in under-investment, followed ➤

➤ by increasingly frequent blackouts. Instead of regulating prices, governments should focus on enabling infrastructure, market liberalization, and a viable long-term investment climate. Instead of price subsidies for all, the poorest members of society without energy access should be helped through capacity building, technology access, and direct investments.

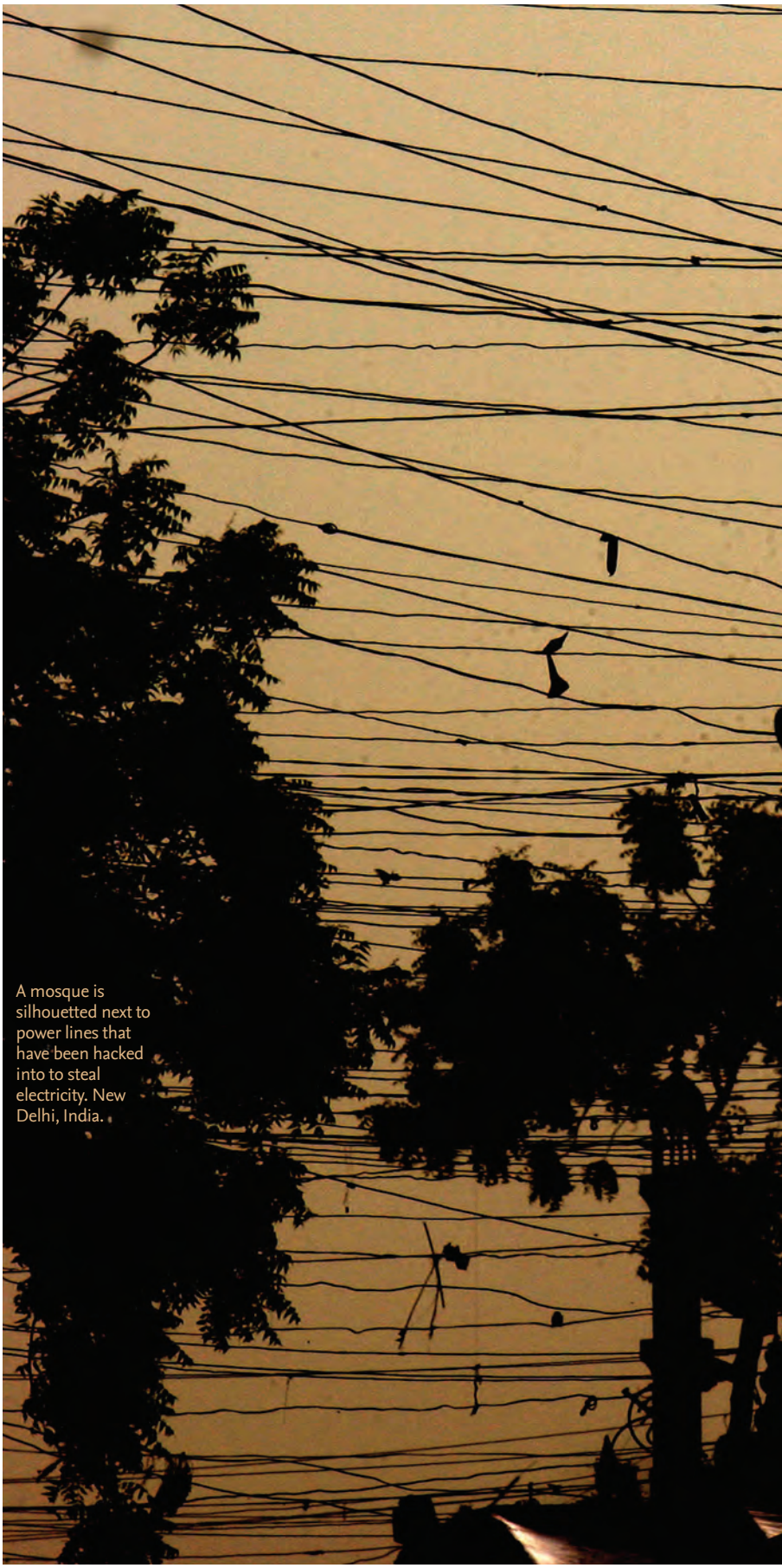
The climate is changing

The Fourth (and most recent – 2007) Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) clearly brought out the relationship between climate change and sustainable development. It also recognized the fact that climate change could become an impediment to achieving the Millennium Development Goals (MDGs). However, it fell short of closing the loop by not explicitly recognizing the linkage with energy access. This is despite the fact that energy (access) has been widely acknowledged as the underlying MDG, or the 'missing MDG'.

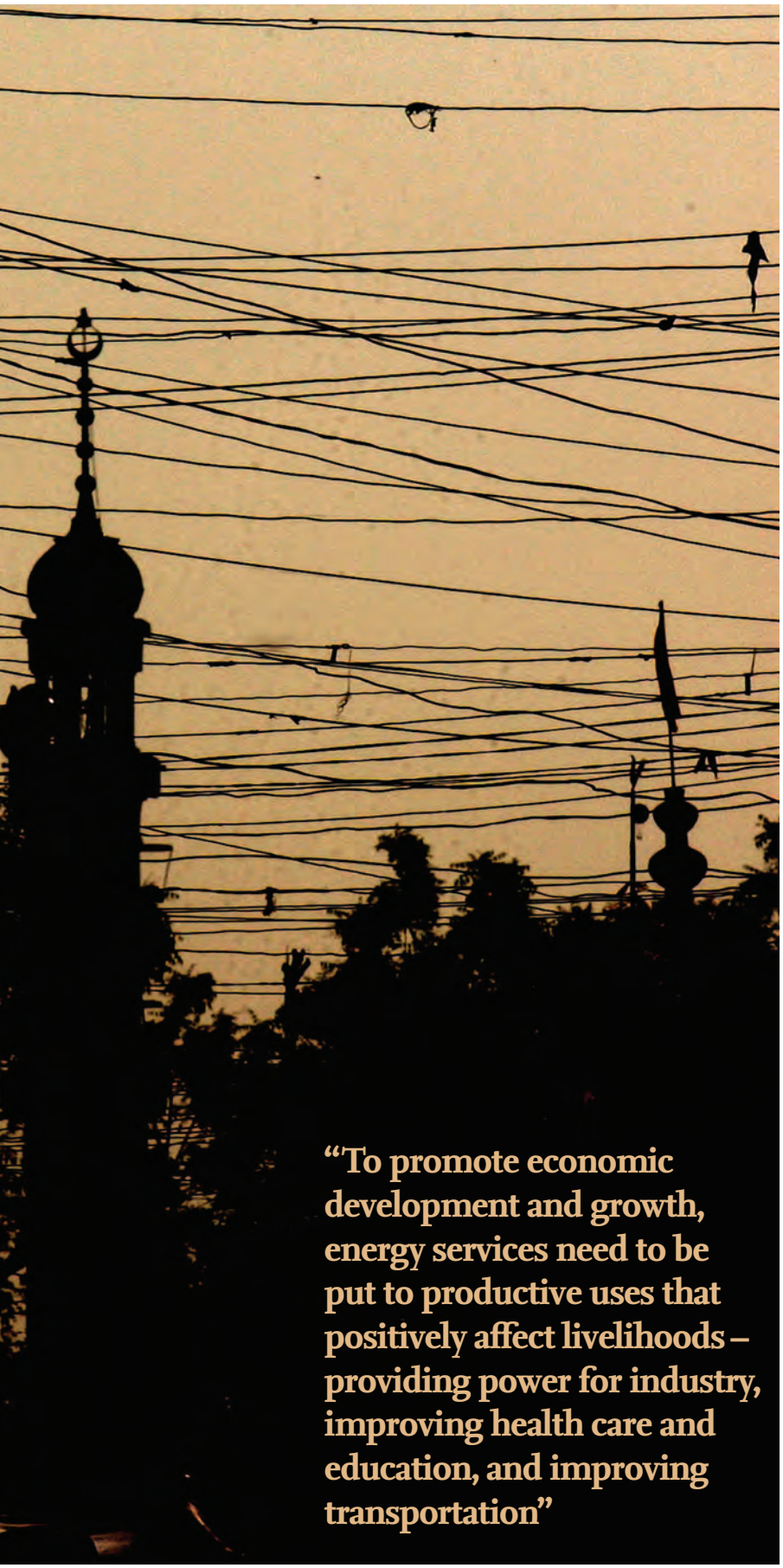
The key to addressing both the sustainable development and climate change needs of the world, therefore, may be to:
(i) set a quantitative goal for energy access, and
(ii) explore the opportunities that would align the challenge of providing energy access more closely with the clean energy development paths of the future.

Should an acceptable goal for energy access reflect the argument of equity, or merely the survival needs of the poor? If the purpose of prioritizing energy access is to mobilize development funds, then the equity argument would not hold. However, to set a goal that would provide energy access at a level that fails to create the opportunities for stepping out of the poverty trap would not be acceptable either. A minimum target, therefore, could be to estimate the energy requirements for meeting the MDGs. Whatever the final target, the purpose of target-setting may be primarily for the purpose of investment planning and sourcing of development funds. In reality, ensuring physical access to energy services, at price levels that would make the services affordable, may be a more rational approach to adopt.

The dividing lines between rich and poor, between urban and rural, between developed and developing have been drawn for so long that a conscious effort is now needed to evaluate the costs and benefits of bridging the technological divides between these categories in the larger interests of global efficiency and climate protection. The fear, however, is that the global community is focused largely on the current fossil energy consumers and greenhouse gas (GHG) emitters. Those who are not part of the immediate problem risk being left out of any emerging solutions. Ensuring low-carbon sustainable energy access is not merely an opportunity to avoid a lock-in to future emission paths by nearly half of the world's population. It is also a major contributor to building adaptive capacity in the most vulnerable populations through the support it provides to all MDGs. If GHG mitigation does not justify much-needed attention to the challenge of energy access, then climate negotiations must recognize the criticality of energy for the adaptation effort. Ideally, given the cross-cutting positive impact of ensuring a sustainable energy access, dedicated funds must be set aside to address this key concern of developing countries.



A mosque is silhouetted next to power lines that have been hacked into to steal electricity. New Delhi, India.



"To promote economic development and growth, energy services need to be put to productive uses that positively affect livelihoods – providing power for industry, improving health care and education, and improving transportation"

Photo: Ami Vitale/Panos

A new direction

UNIDO together with its partners holds a major energy conference every two years. At the last one, in Austria, in 2009, the issue of energy access was prioritized, and the participants identified the following needs:

- International recognition and prioritization of the access issue.
- A robust international framework that clearly articulates an energy access target.
- A detailed implementation roadmap, with interim targets and milestones.
- A mechanism for building in-country capacity and capability across political, governmental, technological, financial, and operational sectors.
- A mechanism for enhancing the investment and financing toward universal access.

These recommendations can be further refined and, as the Ghanaian energy expert, Abeeku Brew-Hammond, writes, we can identify some key areas for action:

- Mobilizing domestic financial resources and making better use of external flows.
- Emphasizing productive uses and income generation.
- Drawing on the full range of resources and technologies.
- Increasing the number of actors and developing effective institutions.
- Developing innovative policies.
- Driving implementation through the application of robust monitoring and verification.

Looking at the challenges at a regional level, the Forum of Energy Ministers in Africa in 2007 stated: "To turn around the performance of the power sector there are three major challenges to be addressed – replacing existing project wish lists with bankable projects; establishing regulatory policies that improve country investment attractiveness; and establishing institutions that have clear roles and are appropriately resourced." In order to coherently implement some or all of these findings, a useful first step may be to design and test a new energy access indicator – this work is just beginning.

Finally, urgent and adequate attention needs to be paid to applying the right business models, creating the decision-making and implementation capacities, and establishing supportive policy/regulatory frameworks for ensuring that technological leapfrogging and institutional re-positioning happen at a rapid pace. The information and telecommunications sectors demonstrated an unanticipated explosion of demand in the developing countries, and a technological leapfrogging from a situation of no access to state-of-the-art communications. This can be used as a precedent for modern energy systems as well. We are convinced that we can accomplish this task, and at the same time support strong new green economies – not doing so is not an option. The scale of the issue, like poverty itself, is enormous, and sometimes daunting to address. But access to energy may be the best entry-point for effectively tackling the problem in the short-term. Its importance is widely recognized. Now we must use this consensus to build on the effective models that exist, and create new ways to unlock the opportunities. ■

The authors would like to acknowledge the support for this article of Morgan Bazilian, energy advisor at UNIDO.

DIPAL BARUA is implementing renewable energy solutions that empower women, create jobs, facilitate rural development, and protect the environment.

Women entrepreneurs transforming Bangladesh

Dipal Barua has a vision. He sees his homeland becoming one of the world's first "solar nations". He believes solar and other renewable energies can transform the lives of the 75 million Bangladeshis who have no access to electricity. To achieve this transformation, he wants to train 100,000 women entrepreneurs to set up their own renewable energy businesses by the year 2015. If Dipal Barua has his way, Bangladesh will, he says, "become a role model for 1.6 billion energy-starved people all over the world".

To realize this vision, the 55-year old Barua has recently founded the Bright Green Energy Foundation. It's the latest step in an illustrious career working to bring sustainable development to the people of rural Bangladesh. Barua was one of the founding members of the Grameen Bank, the Nobel prize-winning, micro-finance and community development bank that was launched in his home village of Jobra in 1976.

"I have devoted most of my life to finding sustainable, market-based solutions to the social and economic problems faced by rural people", says Barua. "I came to realize that a lack of access to efficient energy sources was one of the major obstacles to their development. More than 70% of my country's rural population has to depend on primitive energy sources. This limits people's economic opportunities and damages their health."

In 1996, Barua founded Grameen Shakti, a non-profit organization with a mission to promote, develop, and supply renewable energy.

As managing director, Barua built Grameen Shakti into one of the largest and fastest-growing renewable energy companies in the world. But, as he recalls, attempts to market photovoltaic solar home systems on affordable terms initially faced numerous obstacles. "No enabling environment existed for spreading renewable energy technologies in rural areas. People had no awareness, costs were high, technical knowledge was low, and there was no infrastructure."

"We had to create goodwill and gain the trust of the rural people. We trained our engineers to be 'social engineers' who went from door-to-door to demonstrate the effectiveness of renewable energy. We trained local youth as technicians to ensure that people would have efficient and free after-sales service right on their doorstep."

In a country where approximately 40% of the population lives on less than US$1.25 a day, the cost of even the most basic solar home system – 15,000 Bangladeshi Taka (US$217) – was daunting for many rural households. Barua remembers trying to convince potential customers to invest in solar power systems. "I told people that for the cost of the kerosene they were buying to light their homes, they could buy a solar home system that would last for 20 years or more."

Grameen Shakti received a huge boost in 2002 when low-interest loans from the World Bank and the Global Environment Fund enabled the organization to begin scaling-up its provision of micro-finance agreements. The most popular of a number of options to purchase a solar home system on preferential terms proved to be one with a down-payment of 15% and monthly repayments of the remainder over three years.

By the end of 2009, over 300,000 solar home systems had been installed, bringing electricity to over two million people.

"The solar home system plays a very effective role in bringing 'green' electricity to rural households. Better lighting facilitates children's education and helps women to work and cook", says Barua. "It also enables women to take part in income-generating activities after dark."

And, as Barua points out, the impact on incomes is not restricted to households. "Shops and small businesses have also installed solar home systems in order to stay open after sunset."

In recent years Grameen Shakti diversified, starting a biogas programme to provide cooking gas, electricity, and organic fertilizer, and an improved cooking stove programme to reduce indoor air pollution and the amount of wood needed for cooking fuel. By the end of 2009, more than 7,000 small biogas plants and 40,000 improved cooking stoves had been installed.

Key to Grameen Shakti's success was the deliberate drive to involve women in both the take-up of renewable energy, and the installation and servicing of the energy systems. As Barua remarks, "Women are the main victims of the energy crisis. They are the ones who suffer most from indoor air pollution, drudgery, and a lack of time because of the onerous tasks of wood-gathering and cooking. We believe that women should be transformed from passive victims into active forces of good to bring changes in their lives and the communities in which they live."

Opposite: Bangladeshi women learning to assemble and install solar power systems.

Main photo: Solar entrepreneur in action.

Photos courtesy of the Ashden Awards.

At over 40 technology centres based in rural areas, and managed mostly by female engineers, women undergo an initial 15-day course to learn how to assemble charge controllers and mobile phone chargers, and to install and maintain solar home systems. With further training, they are able to repair the systems. Over 1,000 women technicians have come through the programme, and they have been instrumental in the rapid take-up of the solar power systems.

For Barua, the success of the women technicians programme is one of his most satisfying achievements. "When we started this programme, we were not sure whether we would be able to attract enough rural women or whether they would be able to operate independently. But we trained more than 1,000 women who have developed their self-confidence and now have the opportunity to earn an income of around US$150 a month. These young women from this most conservative of societies can leave home and operate independently as technicians – this was unimaginable only a few years ago."

In 2009 Dipal Barua won the Abu Dhabi government's Zayed Future Energy Prize in recognition of his work to bring renewable energy technologies to rural people. Part of the prize was an award of US$1.5 million, and Barua has used this money to start the Bright Green Energy Foundation.

He plans to build on Grameen Shakti's success, and wants to train 100,000 women, so that they can establish their own renewable energy businesses. "My aim is to provide technical and financial assistance to rural women so they can become 'green' entrepreneurs."

Barua says the Foundation will take renewable energy technologies to the next level of development. "We envisage a future where every household and business in Bangladesh will have access to environmentally-friendly and pollution-free energy at an affordable cost."

He concludes, "If I succeed, Bangladesh will become the land of renewable energy technologies, as it is now the land of micro-credit – a source of inspiration for all. This would be a very positive demonstration of what renewable energy can do for disadvantaged people around the whole world."

● *Interview by Charles Arthur, UNIDO*

Everywhere under the sun

DR. ZHENGRONG SHI is the founder and CEO of Suntech Power, a worldwide leader in innovative solar energy solutions

Look at this satellite image of our world at night. Massive veins of light shoot from urban centres and sprawl across the world's wealthiest regions, creating vibrant grids of economic activity. Even though the countries are not colour-coded with the light pastels of a classroom political map, the two-tone satellite image tells a more important story about access – access to healthcare, access to capital, access to information, and particularly, access to power.

On the whole, bright lights correlate with prosperity founded on energy-intensive economic growth. The world's three largest economic blocks, Western Europe, the United States, and Japan, outshine their neighbours in consistency and intensity, and similarly provide some of the world's longest life expectancies. The bulk of Africa and central Asia remain shrouded in darkness. The contrast that divides an illuminated Republic of Korea from its northern neighbour along the 58th parallel starkly reflects the wealth and opportunity disparities between the two countries.

At the same time, industrialization has historically been accompanied by severe environmental costs, not least the costs of carbon. However, the impact of carbon-based energy production is not limited to global climate change. We shouldn't forget localized environmental damage caused by the process of production of carbon-based electricity, such as the pollution of ground water and soil, or population displacement, or the health damage caused by concentrated ambient air particles in industrial centres.

This is the challenge of our generation. Billions of voices around the world demand greater access to energy, while many others wisely insist that we respect our one and only natural environment. Both goals are legitimate, and neither should yield.

The developmental challenges were no different in China, where Suntech Power was born nearly a decade ago. While China's startling economic growth represents one of the great humanitarian achievements in human history, bringing hundreds of millions of people out of poverty in just a few decades, it has also brought environmental challenges. After receiving a Ph.D. from the University of New South Wales (UNSW) in Australia, I returned to my hometown of Yangzhong, an island that rests in the cradle of the Yangtze River, to find the lands of my youth suffering from the environmental side effects of industrialization.

A global view of the Earth at night, compiled from over 400 satellite images. Photo: NASA

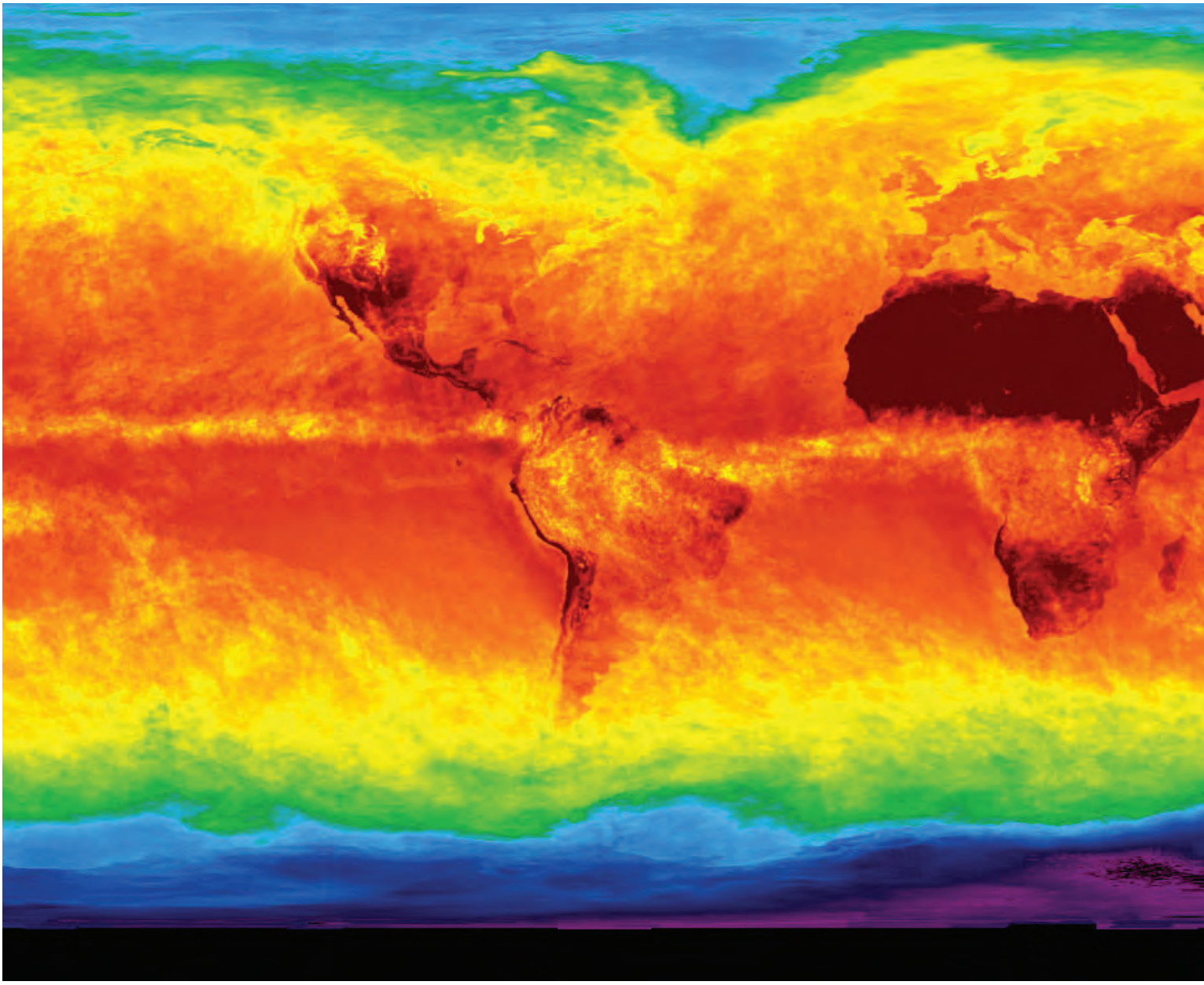
The government of Wuxi, in Jiangsu Province, was eager to take a leadership role to create solutions that promoted equitable economic growth without ravaging our planet and its resources. Thus, with US$6 million in backing facilitated by the local government and local businesses, and with the support of like-minded friends and colleagues from the UNSW, I founded Suntech Power. With a combination of new and second-hand equipment, and a strong belief in our vision, we managed to put together a 10MW capacity solar production facility, which at the time was not insignificant.

Three years later, in December 2005, on the heels of booming global demand for solar products, Suntech Power became the first private China-based company to list on the New York Stock Exchange. Our meteoric growth was made possible, not only by start-up support in China, but by government incentives in the world's wealthiest regions, including Germany, Japan, and California, USA. The international movement to find alternative energy sources gained momentum as governments recognized the need to diversify energy sources due to the scarcity of fossil fuels and the rising cost of extraction; to establish energy independence, to ensure consistent, long-term energy supply; and to find solutions to mitigate man-made global warming.

Against this backdrop, our ability to sustain growth at almost 100% a year until 2008, compete with established competitors, and become the largest producer of crystalline silicon solar panels, was essentially based on our commitment to innovation and quality. Since inception, we have steadily built what is now one of the world's largest solar research teams, with over 350 R&D professionals based in China, Australia, Germany, and Japan. Furthermore, we have nurtured collaborative relationships with leading solar research institutions, such as the UNSW in Australia. This has enabled us to continually push the technology envelope, and repeatedly break records for high efficiency panels. In addition, our focus on minimizing production costs through semi-automated manufacturing processes and home-grown technology has allowed us to keep our promise of the highest quality products at a reasonable price.

As electricity from solar sources reaches grid parity with more carbon-based electricity sources in more markets, we are expecting to be part of an energy revolution that will support long-term sustainable growth in developing and developed markets around the world.

Solar power has a unique opportunity in undeveloped and developing regions, particularly those with over-burdened and/or limited electricity grids. Often, the price of running ➤

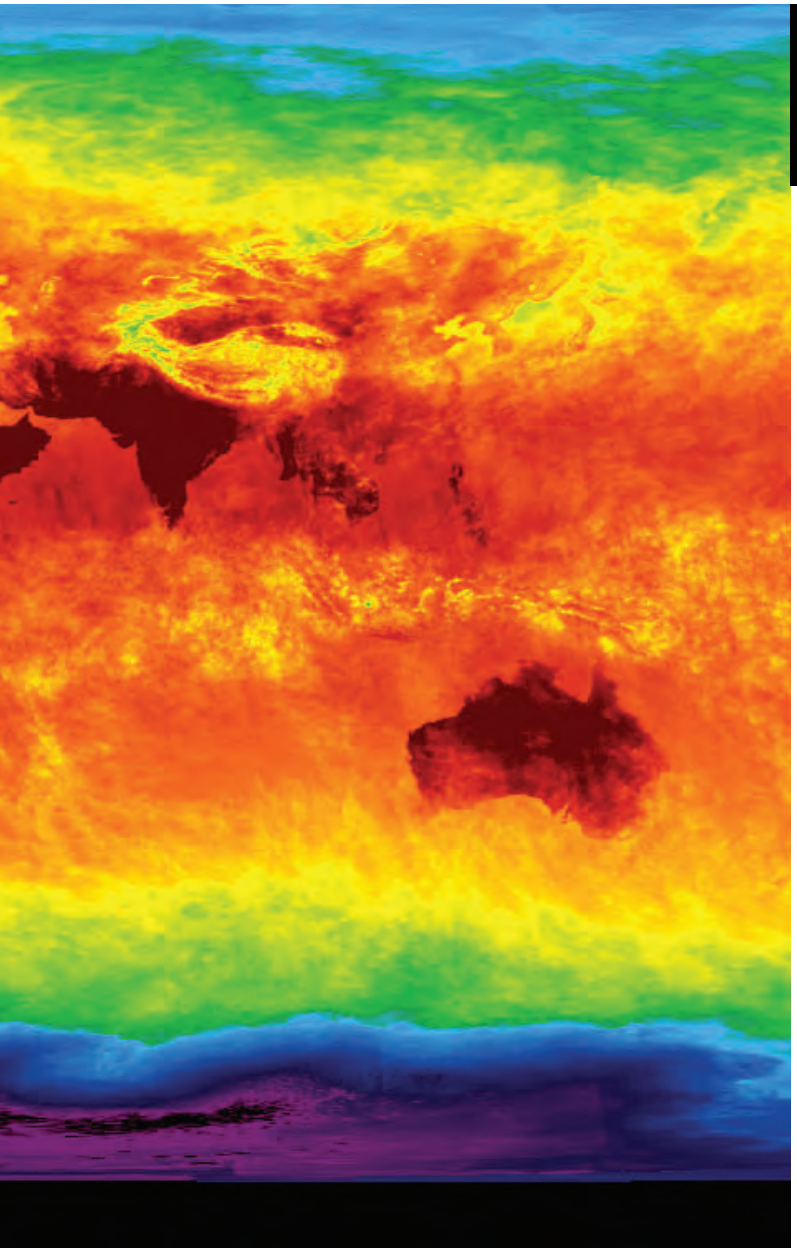


➤ power lines to remote villages, communication towers, medical clinics, schools, or water pumps, far exceeds the price of installing solar power systems. In many markets it already costs more to fire-up a diesel generator than to install a clean and quiet solar power system with a similar power output. In the future, the delivery of electrical power will be characterized not only by centralized production and distribution, but also by the emergence of independent micro-grids powered by renewable energy technology.

Business opportunities are emerging for innovative and entrepreneurial companies to facilitate the adoption of solar power in emerging markets. One of the great added benefits of solar power is that 60-70% of solar jobs are generated in the end-use market. Such jobs are related to on-site solar power system design, the manufacturing of system components, project management, and system installation. By creating reliable access to nature's cleanest and most abundant energy resource, Suntech is providing clean economic and development opportunities everywhere under the sun.

People often talk about the Earth's delicate environment as a 'non-linear system' – in other words, one slight change, plus one slight change, could equal seven major changes. This is as true with our climate, as it is with social development. For example, you need roads to deliver medicine, you need medicine to remain healthy, you need to remain healthy to work, and you need to work if you want to build roads. If you remove any one support from this development structure, the entire system will crumble. This is why we should prioritize solutions that permanently eliminate risk variables, simplifying the equation for communities striving to achieve sustainable development and prosperity for their children.

In this sense, independent solar power systems are like vaccines against blackouts. They prevent those moments when you need to call a doctor but can't charge your cell phone; or when you are teaching your child to read and the lights go out because your generator is out of gas; or when you have to slow down your manufacturing line because the grid can't meet electricity demands during peak hours. Solar power systems provide decades of clean and reliable power, and are designed to perform without problems in the



Left: Irradiance map of the Earth showing average temperatures in April, 2003. The image was created by the Atmospheric Infrared Sounder (AIRS) at an infrared wavelength that senses either the Earth's surface or any intervening cloud. Photo: NASA/JPL

Below: Installation of a Solar Home System in Tibet. Photo: Suntech Power

most extreme weather and environmental conditions. They don't require refuelling or maintenance, and will perform as sure as the sun shines.

To better serve small, off-grid markets, Suntech Power recently launched an exciting product called the Solar Home System, a complete 'entry-level' package for reliable solar electricity generation. Each compact system includes a solar module (from 20Wp-120Wp output), a power storage and control device, as well as an AC electricity socket and energy-efficient light bulbs appropriate for the system's specific power output. Most importantly, the Solar Home System can be easily transported in the back of a car or truck, installed by a layperson with just an Allen wrench, a screwdriver, and a pair of pliers, and operated through a single-button interface. We are proud to announce that the Government of Mongolia, backed by the World Bank, recently purchased 20,000 of our 50Wp Solar Home Systems, and each will provide enough electricity to power light bulbs or to charge cell phones. This is a fantastic example of a government that has taken leadership to promote rural electrification and drive long-term sustainable development.

If you look at an irradiance map of the Earth, it tells a hopeful story. The Sun shines on the rich and poor alike – it does not need a passport or visa, and it is not subject to ethnic conflict, broken infrastructure or political disputes. The vast majority of inhabited land mass is heavily endowed with solar energy. You may not be able to dig an oil well or coal mine in your backyard – or you may not want to – but you can probably harness the energy produced by the Sun.

As the urgency of our mission grows with global energy demands, I celebrate each and every morning knowing that the sun shines on us all. Suntech Power has already delivered nearly 1.8GW of solar capacity to more that 80 countries around the world. From megawatt-scale projects in Spain and Korea, to commercial installations in California and Germany, and off-grid installations in the Himalayas and the Middle East, Suntech is powering a future where everyone has reliable access to Nature's cleanest and most abundant energy resource. This makes me extremely proud because I believe in the power of access. ■

Interview with Michael Spindelegger, Foreign Minister of the Republic of Austria

Energy for development

Making It: **The United Nations Industrial Development Organization (UNIDO) is lucky enough to have its headquarters in the Austrian capital, and Austria has been a great supporter of UNIDO during the more than 40 years it has been located in city of Vienna. How do you see Austria's relations with UNIDO today?**

Michael Spindelegger: As host country, Austria traditionally has close ties with UNIDO. We see UNIDO as a key partner in realizing important development policy goals, and we are convinced of the relevance and quality of UNIDO's work.

Austria has demonstrated its unwavering commitment to UNIDO through its active input, as well as its voluntary contributions as one of UNIDO's major donors. The organization has succeeded in linking the fight against poverty with environmental sustainability, and is therefore offering solutions to the most pressing problems. Today's global crisis requires global responses and a pooling of resources. UNIDO is best suited to link the economic, social, and environmental aspects of industrial development through the facilitation of technology transfer, as well as capacity building measures.

Austria is proud to host an organization that has managed to become a reference point for both economic development and the environment. UNIDO can count on Austria's continuing support to reach our common goals.

Austria's three-year programme (2008-10) for development policy has private sector development as one of its thematic focuses, and micro, small and medium-sized enterprises are the main target group. What is the reason for this focus?

The private sector is a major driver of economic growth, and a thriving business environment is a pre-condition for the development of a dynamic private sector that contributes to poverty reduction. Therefore, Austrian Development Cooperation supports programmes to improve the political, economic, social, and ecological situation. Transparency and equal conditions for all market participants, as well as access to infrastructure, are crucial for these efforts. ➤

➤ Starting up a business is often the only way to make a living; however, it is not easy to get a commercial idea off the ground. That is why our main target groups are micro, small and medium-sized enterprises. We support programmes aimed at increasing legal certainty, and introducing labour market or fiscal legislation that help to create an enabling environment for small entrepreneurs. These projects and programmes impart know-how about business management, and the efficient organization of production processes. In addition, we facilitate access to financial services for small entrepreneurs and others who need seed capital to put their ideas into practice, for example through micro-credit funds or the Austrian Development Bank.

***Making It* is particularly interested to know more about another focus of Austrian development policy: energy. What do you see as the link between energy and private sector development?**

The energy sector is a major contributor to global climate change and local pollution. The focus on power generation from fossil fuels in some developing countries is likely to have far-reaching ecological consequences. The negative effects of climate change risk jeopardizing the development progress achieved so far.

Sustainable solutions are needed to master the complex challenges in the energy sector. A prime objective of our development cooperation is ensuring access to affordable, reliable, and sustainable energy services. We also support applied research and capacity building. The availability of energy is crucial for any enterprise, but also for private households to facilitate domestic tasks like cooking or heating, leaving more time for studying and productive work.

One of the priority countries for Austrian development policy is Bhutan. Can you tell us more about this partnership?

Over the years, Austria has become one of Bhutan's most important development partners. Our fruitful cooperation started in 1986 when we were invited to cooperate in the electrification of eastern Bhutan. Since then, three hydropower stations have been successfully installed and are today fully operational. Besides that, five rural electrification programmes provide access to electricity for more than 1,600 households, and a new programme to cover 800 households in the Phobjikha area is about to begin.

We are also engaged in the field of capacity building: We provide technical assistance and the transfer of know-how to Bhutanese technicians in order to ensure the successful completion of relevant hydropower projects by local companies. Moreover, Austria supports practical training for the staff of the Bhutanese Department of Energy.

Still on energy, can you outline Austria's involvement with the Economic Community of West African States (ECOWAS) Centre for Renewable Energy and Energy Efficiency?

In 2006, the ECOWAS Commission, representing the 15 West African member states, refocused its energy access agenda on the promotion of the use of alternative energy sources, including solar, wind, hydro-electricity, biomass, and other renewable energy sources. As a consequence, UNIDO and European Union member states were approached to give their support to the establishment of an ECOWAS Regional Centre for Renewable Energy and Energy Efficiency. This centre, located in Praia, in Cape Verde, will serve the region by increasing access to modern energy services and enhancing energy security.

Spotlight on Bhutan

The Kingdom of Bhutan is a small, landlocked country in South Asia, located in the eastern Himalayas, and bordered by India and China. Bhutan is home to a population of about 687,000, spread over an area of approximately 47,000 km², with about 70% of the land area under forest cover. Much of the population lives in the central highlands, and almost two-thirds are classified as rural inhabitants.

While economic growth is considered important, Bhutan is concerned with preserving its culture, environment, and national identity. The government sees creating an atmosphere where every individual can seek and achieve happiness as a major goal. Accordingly, the government is pursuing a holistic path of change framed by a unique and home-grown development vision: Gross National Happiness. This political philosophy is underpinned by four pillars that define the effort to balance spiritualistic and material advancement: sustainable socio-economic development; conservation and sustainable use of the environment; promotion of culture; and good governance.

The economy has been largely isolated from the global economic crisis, and is showing signs of recovering from limited negative impacts on tourism and the steel industry. Hydropower could be a major engine of growth and public revenue. Bhutan has limited domestic demand, and surplus power is exported to India. The country has the potential to develop 23,760 MW of hydropower, of which only 5% has been exploited so far. In the next five years the installed hydropower generation capacity is targeted to go up from 1,488 MW in 2007 to 1,602 MW in 2013. In addition, the government is planning to add 10,000 MW of capacity by 2020. To this end, Bhutan and India have agreed on a list of 10 hydropower projects to be developed.

Source: World Bank

National flag of the Kingdom of Bhutan.

Mr Spindelegger (centre-right) at an Austrian-financed water sanitation project in Kamdini, Uganda, July 2009.

With the financial support of the governments of Austria and Spain, operations began in November 2009, and recruitment was completed this February. A detailed work programme is now being prepared. The specific aims in the long run are to give 60% of people in rural areas access to motive power in order to stimulate economic activities, and to give 325 million people access to improved cooking fuel and 214 million people individual access to electricity.

Austria has a strong interest in the economic development of countries in South-east Europe, and two other priority countries are the Former Yugoslav Republic of Macedonia and Montenegro. Can you provide some details about the various energy projects that are being implemented in these countries?

In 1992, through an amendment to its constitution, Montenegro became an "Ecological State". As a contribution to energy-efficient and ecologically-sustainable construction in Montenegro, the Austrian Development Agency is financing the planning costs, construction supervision, and supply of eco-efficient materials for the construction of the United Nations' new offices in Montenegro.

Austria also supports a number of energy projects in Macedonia, such as the geothermal project in Kocani, which should help Macedonia to achieve energy independence. Its main objectives are the strengthening of the use of geothermics as a modern alternative form of energy, the more efficient use of this energy, and technological improvements in the supply of heat energy.

We also support a UNDP pilot project in Macedonia, which aims to improve energy efficiency in the building sector and enhance the awareness and capacities of stakeholders involved in energy efficiency issues. In the long run, energy consumption in residential and public buildings should be minimized, thus not only reducing energy demand and greenhouse gas emissions, but also increasing the energy independence of the country. ■

UN eco-premises in Montenegro

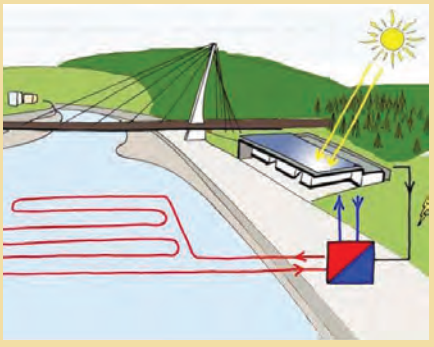
The construction of a new, environmentally-friendly, United Nations building in Podgorica, the capital of Montenegro, is about to begin. The building, located next to the Millennium Bridge spanning the Morača river, will house the various UN agencies operating in Montenegro.

The building is intended to make a significant contribution to the promotion of sustainable, ecological, and low energy building philosophy and technology, not only in Montenegro, but also in South-east Europe as a the whole. The description of the building as 'ecological', rather than 'energy-efficient', reflects the use of locally-available building materials and the application of environmentally-friendly technologies. The project highlights the UN's determination to promote sustainable development and the importance of environmental building principles.

The eco-premises' ventilation system will work on a displacement principle, with heat generated in office spaces used to drive a natural air circulation system. Energy for additional heating and air-conditioning will be provided by water from the Morača river: in the summer, the river water temperature is lower than the outside air, and water will be pumped through the building to cool it down; in the winter, the offices will be warmed by river water that is heated and pumped by solar power. Solar panels fitted on the roof's 1400m² surface area will satisfy the building's entire annual energy demand.

The building is based on the preliminary design developed by the Austrian architect, Daniel Fügenschuh, and the British engineering company, King Shaw Associates. Completion is scheduled for late 2011.

The building will be heated and cooled by water from the Morača river.



A global challenge

Demand for energy is expected to increase by 40-50% over coming decades, driven primarily by population growth and increasing prosperity. A rising population creates a greater need for lighting, heating, transport, industrial production, and so forth. Around 1.5 billion people currently live without electricity. Their expectations of growing prosperity are legitimate.

All serious forecasts show that coal, oil, and gas will be the most important energy carriers for several decades to come. Even in the "two-degree" scenario from the International Energy Agency (IEA), the consumption of oil and gas is estimated to increase.

Emissions are an undesirable, but unavoidable consequence of the growth in energy consumption. The fundamental dilemma facing all of us is therefore how to supply the world with sufficient energy, while simultaneously reducing greenhouse gas emissions.

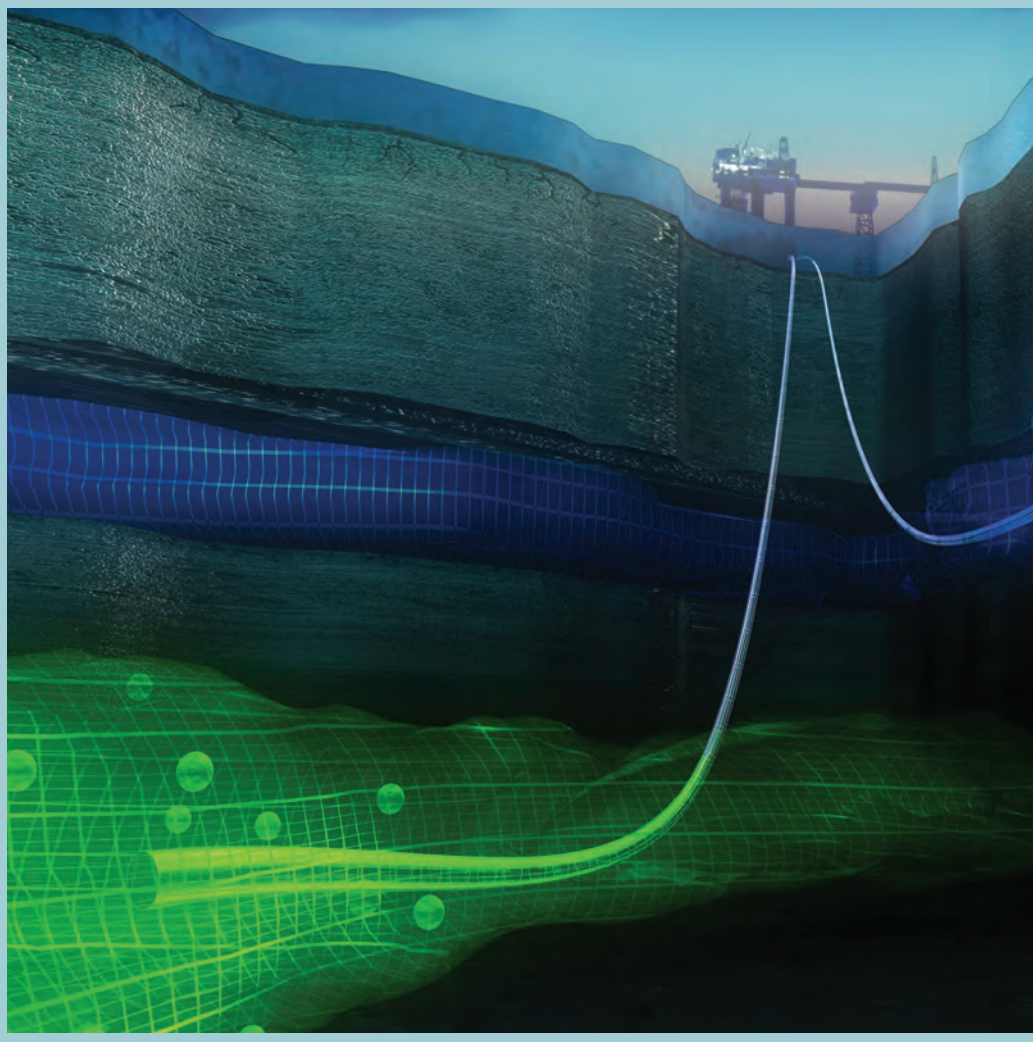
A wide range of mitigation efforts are required to reduce greenhouse gas emissions: energy efficiency, carbon capture and storage (CCS), fuel switching (e.g. coal to natural gas), nuclear power, renewable energy, etc.

Knowing that the world will be dependant on fossil fuels for the foreseeable future, there is a need to develop technology to reduce emissions from the use of these fuels. I cannot see how CO_2 emissions can be reduced in the medium to long term without a major deployment of CCS. This is supported by many key analyses, including the IEA's World Energy Outlook.

Industrial scale CCS

CCS is a climate mitigation tool that captures carbon dioxide (CO_2) and stores it in deep geological formations, away from the atmosphere. CCS is already being used on an industrial scale, and Statoil is currently involved in three large CCS projects: Sleipner and Snøhvit (both off the coast of Norway) and In Salah (in Algeria). All of these are projects where CO_2 is removed from the wellstream at high pressure in a closed system, as distinct from the capture of CO_2 from the flue gases which are produced, for example, during the process of burning fossil fuels in power generation.

Although there are great expectations about full scale CCS, and a lot of good technology development is taking place, it is important to be aware that, so far, no large CO_2 capture from flue gases has been realized. The costs of developing huge CO_2-capture plants are currently too high, and further technology development is needed in order to make CCS a really significant way to reduce carbon emissions.



On the political level, the attention being paid to CCS is growing. The European Union's new climate package includes a CO_2-storage directive, as well as a revision of the EU emission trading system to provide financial incentives for CCS. CO_2-reduction efforts in the United States, Canada, Norway, the UK, and Australia, also include substantial support schemes for CCS in this introductory phase.

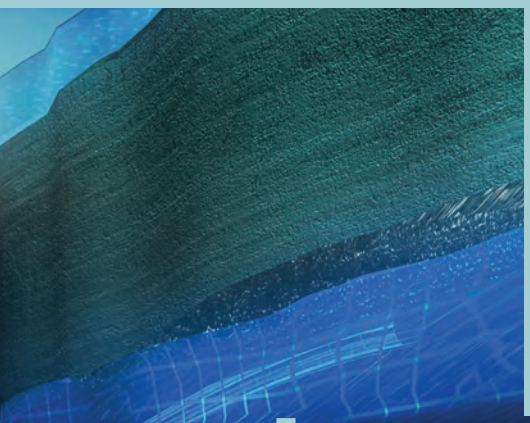
In order to make CCS a part of the response to climate challenge, I see four main challenges:

- The costs of capture technology, which are currently way higher than CO_2 emission costs.
- The absence of a firm legal basis.
- A lack of public awareness.
- Some unsolved issues related to CCS infrastructure.

A price on CO_2 emissions

Mankind has been emitting CO_2 into the atmosphere for centuries. So far, most emissions do not have a cost attached to them. Before CCS can realize its potential as a mitigation tool, industry must be convinced that the long-term cost of emitting CO_2 into the atmosphere will be as high as, or higher, than the cost of CCS; i.e. CCS has to become commercially-viable in its own right. One important element here is the capital cost and energy use associated with CO_2-capture, which have to be reduced. (The high cost of post-combustion capture is related to the need to first collect and store huge volumes of flue gas, and then to heat it in order to release and capture the CO_2.)

One of the most important factors holding back the deployment of CCS – and indeed all climate mitigation efforts – is therefore the lack of a world-wide, sufficiently high, and predictable, CO_2-price. The lack of such a price (as well as the absence of a global mechanism whereby the CO_2 emissions that are stored are not counted as "emitted") means the pace of large-scale global deployment of CCS is being slowed down. Financial and technical support is needed to make CCS affordable and transferable, particularly to developing countries where energy demand is growing so rapidly. The CCS project at In Salah in Algeria is a very interesting example as it is located in a developing country without a greenhouse gas limitation



Carbon capture and storage is the separation, capture, transport, and storage of CO_2 that results from the production, processing and burning of oil, gas, and coal. In this illustration of Statoil's Sleipner project in the North Sea, CO_2 separated from the project's natural gas production stream (on the left) is captured and then injected back into the permeable rock beneath the seabed (on the right).

Carbon capture and storage

A necessary climate mitigation tool

Helge Lund, President and CEO of Statoil, an international energy company with operations in 40 countries, and a world leader in CCS development and application.

target. It is my belief that many more industrial CCS projects of this type could have been realized if a mechanism had existed to finance such projects. Over many years there have been attempts to include CCS in the Clean Development Mechanism (CDM), but this has so far failed to materialize.

To date, no large scale CO_2 capture projects from flue gases (power plants, industrial flue gas) have been realized. Thus, we have no cost experiences to refer to, and cost estimates based solely on paper studies vary by several hundred percent, depending on country, company, site chosen, or whether it is a retrofit or new build. There is no database for this type of capture cost, and so far there has been little sharing of capital expenditure estimates between commercial power plant actors around the world.

Public-private partnership is necessary in a pre-commercial period until the mitigation cost has come down and the cost of emitting has gone up to a sufficient level. Most countries need to increase their pre-commercial funding for the early demonstration phase of CCS.

At the Mongstad refinery in Norway, our plan is to capture CO_2 from the exhaust gases from the combined heat and power plant, and from different emission points at the refinery. This is technologically challenging. Statoil, together with the Norwegian authorities and other industrial partners, has therefore established a European Carbon Dioxide Test Centre at Mongstad. Here, two capture technologies for improving performance and reducing costs will be put to the test.

Legal issues

A substantial effort to establish a legal framework for CCS has been carried out in the EU, the US, Canada, and Australia. However, there are some important issues that are still outstanding. These include regulations regarding the transfer of long-term liability for storage sites between a commercial storage operator and the government, the licensing of storage acreage, work programmes to obtain such licences, and regulations concerning environmental, safety, and health issues.

One recent success has been to have the London and Ospar Conventions rewritten to allow CO_2 storage in geological formations under the seabed, and to permit trans-boundary transportation of CO_2. Much good work is being done by governments in this area; however the procedures for implementation of these Conventions makes for relatively slow progress in ratifying any changes.

Even with a legal framework in place, public acceptance and understanding will be essential for projects to go ahead. Industry and government must work to improve the awareness, understanding, and general acceptance of the merits of CCS as a viable mitigation tool.

CCS infrastructure

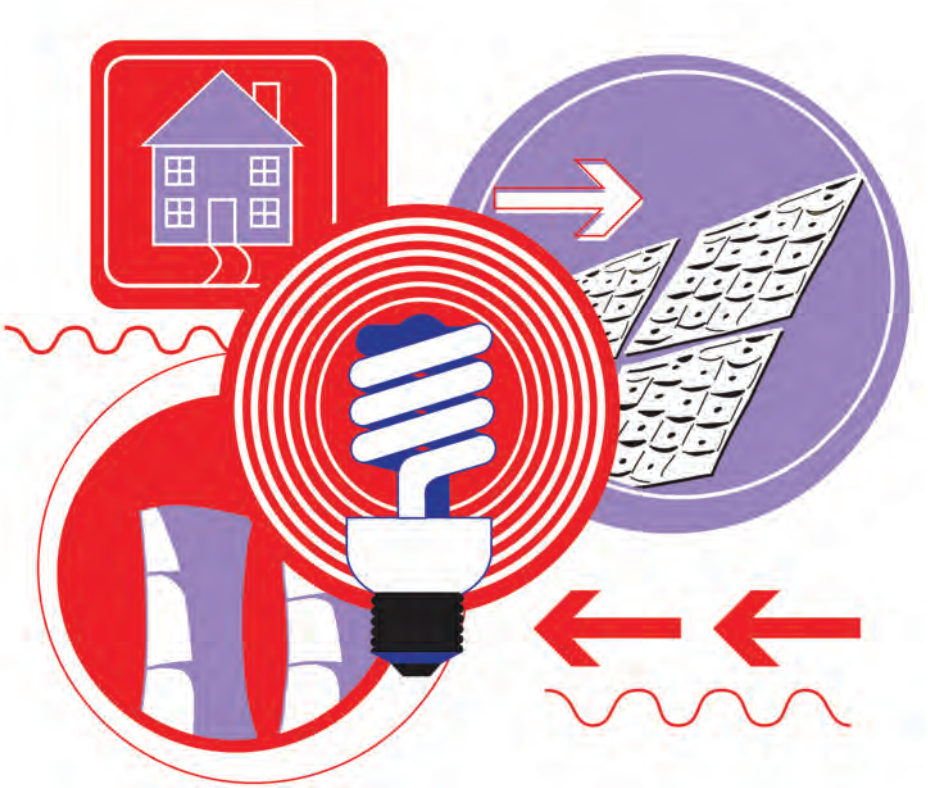
A framework for CCS infrastructure, in particular transport networks and storage sites, has to be in place in order to deploy full-scale CCS. If CCS is to be captured from many different sources, some sort of gathering system to transport the CO_2 to the storage sites has to be developed. A CO_2 transport network should be planned and set up in parallel with the large scale development of capture facilities. There is a pressing need to establish more operating storage sites in order to learn about the practicalities of storage and to demonstrate to the public that safe storage is possible under various geological conditions.

Statoil has more than 13 years of experience of CO_2 storage at the geological formation at the Sleipner field in the North Sea. There the CO_2 is prevented from seeping into the atmosphere by an 800 metre-thick cap rock above the actual storage location. By the end of 2008, eleven million tonnes of CO_2 had been stored there. Statoil has been very open with the monitoring data from Sleipner, which has been mapped and analysed by various research projects partly financed by the EU. Seismic testing in June 2008 showed that the CO_2 plume is behaving as planned.

Despite some unsolved issues, we believe CCS will be one of the central CO_2 mitigation tools. We need pioneers from industry, governments, researchers, and environmental NGOs to explore this path. Climate change is the biggest challenge of our time, and finding sustainable solutions is a matter of urgency. Everyone has a substantial responsibility, and everyone must contribute.

For a long-term industry player like Statoil, a level playing field and good predictability are crucial. In this context, global political leadership must accept its responsibility, and not underestimate its actual room for manoeuvre. ■

Financing renewable energy



Extracted from *Private financing of renewable energy – a guide for policymakers* written by Sophie Justice, and published jointly by the Renewable Energy Finance Project, Chatham House; Bloomberg New Energy Finance; and the UNEP Sustainable Energy Finance Initiative.

A broad range of financial institutions are now investing in or lending money to the renewable energy (RE) sector. Global investment grew exponentially from US$22 billion in 2002 to US$155 billion in 2008 when, for the first time, investment in new RE power generation capacity (including large hydro) was greater than investment in fossil fuel generation. The financial crisis in late 2008/first quarter 2009 did hit the sector heavily, although a bounce-back was subsequently observed, and investor interest in the sector remained throughout.

Financial institutions operate on a risk and return basis evaluating each potential investment opportunity on its merits. Project assessment, documentation, and due diligence are conducted in a manner consistent with investments in other sectors. The range of RE risk profiles can be well matched to the spectrum of financial institutions from banks, pension funds, private equity and ventue capital. However, the RE sector requires a clear policy environment to deliver the project economics to attract private debt and equity. Policy and regulation continue to be central to ensuring the long term stability of projects from a revenue and operation perspective. It is imperative that both regulation and policy be clear, of a long duration, and legally based, in order to deliver growing volumes of private funds into the RE sector.

RE projects in emerging markets, or developing countries, must address the typical due diligence and investment scrutiny, but face additional complications that require careful mitigation. Particular focus will be placed on:

- **The stability and maturity of the political system**: this influences the ability for projects to reach a successful conclusion, as the greater the instability, the smaller the pool of investors and commercial lenders to fund projects. Mitigation can include political risk insurance provided by bodies such as the Multilateral Insurance Guarantee Agency (MIGA) insuring against contract default, currency inconvertibility, expropriation, and war and strife.
- **Overall legal, regulatory, tax and business environment**: if it is difficult to do any business on a legal and transparent basis, then implementing a RE project for long-term power generation will prove challenging. Investors will naturally favour countries which engage in standard business practices, for example for board

"Lenders and investors need to be conscious of market differences between countries, hence the need for appropriate technologies, off-grid solutions and the inclusion of renewable energy projects"

appointments and annual reporting. The availability of long term power purchase agreements, concessions, and sound legal rights over project land, all improve the overall risk profile.

Emerging markets and developing countries with their smaller economies feature less mature stock markets and supporting regulations, and therefore experience comparative liquidity restrictions. As mitigation, investments can be structured in a manner that recognizes this, for example, with strong government or sponsor guarantees confirming the on-going revenue stream. Working with a respected local party frequently improves project quality and accelerates delivery.

Local currency: investments made in local currency can be subject to exchange rate fluctuations, devaluation or the vagaries of domestic monetary policy. Partnering with local financial institutions, potentially to structure dual currency loans, can provide the required mitigation to the lenders and project sponsors. Alternatively, projects can be structured with credit guarantees, risk guarantees, and hedging products provided by development banks and export credit agencies.

Energy market and infrastructure: Lenders and investors need to be conscious of market differences between countries, hence the need for appropriate technologies, and off-grid solutions, and the inclusion of smaller or discrete RE projects. Projects can be hampered by a shortage of credit-worthy recipients for the power generated by proposed RE projects. The challenges posed by a lack of infrastructure and the impact this can have on project construction and on-going operation also need to be considered.

Public finance in emerging markets can be a very effective means of enabling RE projects, particularly given the higher level of risk often associated with developing markets. Direct grants and the provision of commercial or soft loans can considerably assist project deliverability where either a commercial project faces a funding gap or a commercial lender is unwilling to shoulder the entire project risk. However, grants or loans need to be available, structured and delivered in a commercial and timely manner consistent with the project development and the timelines of the other project investors and lenders to ensure the RE project does not founder. Private financiers have commented that historically many projects have failed when in partnership with public finance, owing to an apparent lack of 'fleetness of foot', commercial perspective and flexibility – all required problem-solving features in successful private transactions.

■ The full report can be read online at: www.chathamhouse.org.uk/publications/papers/view/-/id/811/

How policy-makers can make a difference

MARIANNE OSTERKORN, Director General of REEEP (Renewable Energy and Energy Efficiency Partnership), tells *Making It* about some of the organisation's experience of 130 targeted projects over the past five years. REEEP is a global partnership that works to reduce the barriers limiting the uptake of renewable energy and energy efficiency technologies, with a primary focus on emerging markets and developing countries.

What does the term "targeted project" mean?
Basically, there are two elements that are critical to ensure the uptake of clean energy in a given country: first and foremost, a country needs stable policy and regulatory frameworks that create the conditions that allow the market to develop. Second, it needs financing and business models that make renewable energy and energy efficiency a bankable prospect, particularly for entrepreneurs. REEEP projects are evenly split between these two types of targeted interventions.

On policy and regulation, you have some clear ideas about what works and what doesn't. What are your opinions based on?
My opinions are based on experience. About half of the 130 REEEP-funded projects, either completed or in progress, relate specifically to assisting governments with clean energy policy and regulation. We've funded policy projects in places as diverse as India, Ecuador, and Fiji. The formulation of a Renewable Energy Law in post-war Liberia, the revision of China's Renewable Energy Law, and a project with the UNDP, which led to the passing of a Renewable Energy Law in Kazahkstan last June, are three recent examples.

On regulation, we have worked with Mexico's energy regulator to identify new procedures and codes to support renewable energy development. Looking forward, we are currently funding a study by the Centre for Renewable Energy Development into how China could meet 30% of its 2030 energy needs with renewable sources, as an input to the ➤

➤ government's five-year planning cycle.

Do you think governments can play an important role in the low-carbon transition?

Yes, absolutely. In most developing countries, the energy sector is owned and controlled by the state, either directly or indirectly. And regardless of ownership, the energy sector is always heavily regulated, again by government. So, government holds the key to energy transformation. This is a very basic reality that is often overlooked.

What, in your view, should governments concentrate on first?

The so-called "low hanging fruit" has got to be energy efficiency policy and regulation. This isn't just something for developed countries. In developing parts of the world, energy efficiency has huge potential to help relieve peak loads and slow the demand increase for new power plants.

What kind of tools work in promoting end-use efficiency?

Standards and labelling are the most effective means. They require little government spending and they are relatively easy to implement. With appliance labelling for example, private households can make an informed choice when buying, and manufacturers have an interest in improving the technical efficiency of lighting, refrigerators and air conditioners. As an example, REEEP supported Africa's first appliance labelling programme in Ghana. We have also helped to finance the expansion of the APEC Energy Standards Information System (ESIS), so other countries don't need to start from scratch in developing appliance standards or labelling programmes.

What can sub-national entities do to promote efficiency?

Energy efficiency in buildings is a good example here. Building codes are often local or provincial, and setting low energy consumption standards for new buildings is a good long-term strategy that can begin here and now. REEEP is also working through its Energy Efficiency Coalition (EEC) to set up local stakeholder networks to advance building energy efficiency on the ground. One such network has been created in Mexico, and similar efforts are beginning in China.

On renewable energy, what actions do you recommend to policy-makers?

There is really no one-size-fits-all solution with renewable energy. The solutions here will depend on a country's geography and climate, local politics and many other variables.

That said, solar water heating (SWH) is now commercially viable in most developing countries. It is a low carbon energy technology that's superior to the conventional alternatives, and at the same time, is an effective demand-side management tool for areas with peak power shortages. Mandating SWH in all new and retrofit buildings can have a huge effect. This is another measure than can be carried out at city or state/provincial level. Cape Town's efforts in this regard, which have been supported by REEEP, are exemplary.

What other advice do you have for policy-makers?

Well, it would be two thoughts. The first is about rural electrification, for which many countries already have ambitious programmes in place. Here, I would caution policy-makers not to just think in terms of rural electricity, but in terms of rural energy. For example, if electricity is provided for light, but there is still a need to gather firewood for heat and cooking, electrification won't contribute to sustainable development as intended.

Second, in cities and suburbs there is a similar need to think holistically. Renewable electricity generation is one building block, but waste management and energy efficiency should also be included in an integrated energy policy for an urban area. ■

Getting FiT

By **MIGUEL MENDONÇA**, research manager at the World Future Council

A feed-in tariff (FiT) is a renewable energy law that obliges energy suppliers to buy electricity produced from renewable resources at a fixed price, usually over a fixed period.

The feed-in tariff mechanism has been used in over 50 countries worldwide, driving the majority of renewable energy investment and deployment to date, and creating world-leading industries in several countries. It has pushed costs down and efficiencies up, and can be adapted for least developed countries and emerging economies. Well-designed and implemented FiTs can provide access to energy, while reducing fossil fuel dependency and creating low-carbon growth. The critical question, however, is how to fund them.

Some key proposals emerged around the UN Climate Change Conference, COP15, aimed at breaking the deadlock over financing technology transfer from the global north to the global south:

The World Wind Energy Association and the International Renewable Energy Alliance advocate a Global Renewable Energy Investment Programme, containing a global FiT fund, to be sourced from obligatory annual contributions from the Annex I (developed) countries. They also suggest ways of reforming the Clean Development Mechanism (CDM) to be more effective for the deployment of wind power and other technologies.

The World Future Council (WFC) has proposed 'creating new money' for

Village mini-grids can use the FiT mechanism to sell excess electricity to a local energy utility.

Image: Alliance for Rural Electrification

climate-protecting measures, a model recently applied to the banking sector. Governments can authorize this in the form of the Special Drawing Rights of the International Monetary Fund. This should be interest-free and non-inflationary.
A specific FiT design for LDCs is being pursued by the WFC. A new book, *Powering the Green Economy – The Feed-in Tariff Handbook* suggests methodologies for both grid-connected and off-grid installations, including village mini-grids. It also proposes the creation of a dedicated FiT fund, sourced from national budgets and/or international donors.

Greenpeace and the European Renewable Energy Council have also explored the creation of a major fund, called the Feed-in Tariff Support Mechanism (FTSM). It would link FiTs with emission trading schemes and/or funding arrangements, and use existing international finance arrangements and institutions to deliver project finance at low risk. It seeks to create a reliable alternative to CDM which connects bottom-up planning with top-down financing. It would be funded by contributions from OECD countries.

Another emerging possibility is 'overcharging' commercial and industrial electricity customers in order to generate FiT funds.

A proposed model to adapt the FiT scheme to off-grid areas in developing countries is the so-called 'Renewable Energy Premium Tariff' (RPT). Like a normal FiT, it rewards performance rather than simply supplying the initial capital investment funds for the installation. The RPT has been analysed under different ownership, regulatory and institutional frameworks, and options for practical applications are being considered.

In 2009, the emerging economies of India, China, and South Africa, have all introduced national FiTs. South Africa, with both major power capacity constraints and significant carbon reduction targets, has embarked on the establishment of an ambitious FiT, but there remains a need to finalize the operational details to enable power purchase agreements to be signed. Kenya also established a FiT in 2009, and Uganda, Botswana and Mauritius are looking at FiT legislation. China has introduced a FiT for wind, which replaces the tendering system. The National Development and Reform Commission, the country's economic planning agency, expects it to guide investment decisions more clearly. A FiT for solar power is anticipated. India has regional FiTs in around half a dozen states, but has now opted for a national scheme, covering all renewables, with attractive rates of return.

"Well-designed and implemented FiTs can provide access to energy, while breaking fossil fuel dependency and creating low carbon growth. But the critical question is how to fund them."

The main recommendations for FiTs in the developing world concern financing – guaranteeing international monies for 20-year FiT-funds – and creating a strong institutional and legal framework. Existing funds are often linked to management by international institutions such as UN bodies or the International Monetary Fund or World Bank, but this requires exploration. The International Renewable Energy Agency (IRENA) may be able to play a strong role in the creation of this framework.

FiTs could be combined with the CDM, as the additionality criteria have been altered since November 2001, to allow coexistence with established national support schemes (additionality is where emissions reductions must be beyond or additional to what would have happened in the absence of the project). However, the area is complex, and with continuing uncertainty over international mechanisms such as the CDM, it is recommended for now that FiT schemes stand alone and apart from anything that raises investment risk. ■

Grassroots industrial policies

As an appetizer for the third issue of *Making It*, **ALICE AMSDEN**, Professor of Political Economy at the Massachusetts Institute of Technology (MIT), shares some thoughts on industrial policy and poverty reduction.

Today's grassroots approach to poverty reduction shouldn't be equated simply with boot-strap operations or self-help schemes. The bottom-up policies and institutions that are now being experimented with in Africa and other poor regions have highly innovative elements.

One revolutionary element is that poor people today are no longer regarded as being lazy, as they were in the past! Instead, they are seen as being highly entrepreneurial. The latent entrepreneurship of the poor is supposed to be released with the application of greater human capital: health care, housing, education, training, and the 'freedom to choose', as Nobel Laureate Amartya Sen has emphasized.

New types of financial institutions, such as the Grameen Bank, and new types of financial instruments, such as micro-loans, can help get poor people started. This type of supply-side human capital formation can be further enhanced by combining state-of-the art, yet appropriate, technologies designed for small-scale operations. An example is the low-cost cooking stove that world-class inventors have been working on to help poor people around the world avoid

Alice Amsden is a member of the UN Council for Development Policy

environmental degradation and lung disease from indoor fumes.

The agent of change is no longer considered to be the government, but rather the non-governmental organization, or NGO. Instead of paid labour, socially conscious volunteers from developed, as well as developing countries can help advance the anti-poverty cause.

Yet, despite these innovations and enormous efforts at human capital formation, poverty in most poor areas of the developing world doesn't seem to have decreased. World Bank data for Africa show that, between 1981 and 2005, the percentage of people below a socially accepted living standard (such as the equivalent of US$1.25 a day) has not fallen. Life expectancy in the poorest countries remains unbelievably low, at around only 40 or 50 years. Entrepreneurship has still not fundamentally changed the way poor people live.

Demand-side policies

Why this is so may be attributed to a fatal flaw in grassroots thinking: that supply creates its own demand, as first mistakenly conceived by a French economist, Jean Baptiste Say, in the eighteenth century. The supply of potentially productive entrepreneurs has not automatically created the demand to profitably employ them. The reason for this is that too few policies operate on the demand side (fiscal, trade, labour and industrial) to create more economic opportunities for entrepreneurs to exploit. Simply, no matter how healthy or educated a poor job-seeker might become, there are not enough good business opportunities or paid jobs to go around.

Opportunities for entrepreneurs have to be increased on the demand side. Can we use 'grassroots industrial policies' to create professionally-managed firms that will increase demand for the services of clerks and administrators, production workers, parts suppliers, and service providers?

One objective of such demand-side policies would be to create 'professional' business enterprises in rural regions and low-income urban communities that are larger than micro-enterprises, in order to diffuse modern management techniques and engineering practices to inexperienced entrepreneurs, thereby enabling them to gain hands-on business experience. Experience is probably what entrepreneurs in poor countries most lack when striving to export their products to neighbouring and world markets.

Role models

Just as grassroots poverty reduction has moved beyond self-help programmes, successful 'role models' now exist to help poor countries enter the charmed circle of experienced manufacturers and service providers. In terms of securing sources to finance such projects, there are now 40 or more poor countries that produce more than one million barrels of oil a day, and OPEC members provide a role model for creating excellently-managed national oil companies within political systems that were once regarded as highly corrupt. The national oil companies of OPEC members have managed to reverse brain drain, and create investment opportunities for small

and medium sized parts and component suppliers in related sectors. Petrobras, Brazil's oil giant, has a programme underway to create 80,000 such enterprises. As these companies become professionally managed, they will offer good opportunities for experienced managers, engineers, and shop-floor supervisors to return home from overseas, further increasing investment opportunities in a virtuous circle. Without industrial policies to raise investment prospects, such talent would be totally lost to countries that need it the most.

Meiji-era Japan (1868 -1912) is a good example of a country that accelerated the acquisition of hands-on experience by creating 'model factories,' especially in the labour-intensive silk industry, based on a natural resource. Although many such companies failed initially, their trained personnel went on to open factories that ultimately succeeded, creating Japan's leading sector before World War One.

Reverse brain drain

Taiwan Province of China, small in population size like many poor countries today, built networks of small enterprises with the aid of government promotion policies, which then dotted the countryside and provided employment opportunities for under-employed farmers. Initially these firms were regarded as inefficient and backward, but they quickly improved as government techno-centres opened to assist them, and 'brain drain migrants' returned home to become owners of their own companies. These techno-centres offered higher salaries to experienced workers and engineers to reverse brain drain. But the costs ultimately paid off in the form of a more experienced and educated local workforce. To establish more entrepreneurial enterprises and paid jobs, the government provided incentives to the Singer sewing machine company to locate a subsidiary in Taiwan Province of China, which then acted as a tutor to local small and medium sized entreprises producing the thousands of parts that go into a sewing machine.

China's 'town and village enterprises' (TVEs) were an ad hoc type of institution that combined the unemployed labour of rural regions with the excess capital equipment of large state-owned enterprises, coordinated by local political leaders. The TVEs are credited with the ultra-fast growth in both output and employment that followed China's 1978 reforms. Today, modern second-hand equipment can be bought from abroad.

Most "investment climate" reports (that is, feasibility studies) undertaken by the World Bank and private consulting firms indicate the potential for profitable investment opportunities in poor countries. As the owner of one of The Republic of Korea's big business groups remarked after he came back from Africa, all he could see growing on the trees was money, although he conceded that to get it would take hard work and coordination.

First step

Today, with role models around to emulate within the developing world itself, there are less grounds than ever for fatalism, or for thinking that nothing governments do can work. Although the grassroots is where new industrial policies and investments in small-scale modern industries must ultimately reside, the first step must be to bring the demand side back into the picture, and to look beyond the grassroots and strictly supply-side measures. ■

MakingIt
Industry for Development

FURTHER READING

Amsden, Alice – Escape from Empire: The Developing World's Journey through Heaven and Hell

Barnes, Douglas F. (Editor) – The Challenge of Rural Electrification: Strategies for Developing Countries

International Energy Agency – Transport, Energy and CO2: Moving Towards Sustainability

Jacobs, David and Kiene, Ansgar (World Future Council) – Renewable Energy Policies for Sustainable African Development

Kamkwamba, William – The Boy Who Harnessed the Wind

Kane, Gareth – The Three Secrets of Green Business: Unlocking Competitive Advantage in a Low Carbon Economy

Mendonça, Miguel et al. – Powering the Green Economy: The Feed-in Tariff Handbook

Shaad, Brian and Wilson, Emma – Access to Sustainable Energy: What Role for International Oil and Gas Companies? Focus on Nigeria

UNIDO – Policies for promoting industrial energy efficiency in developing countries and transition economies

UNIDO – Energy Efficiency: A Low-Carbon Path for Industry

UNIDO – Navigating Bioenergy: Contributing to Informed Decision Making on Bioenergy Issues

Von Uexküll, Jakob (World Future Council) – Breaking the Funding Deadlock: Creating New Money to Finance Climate Security and Climate Justice

FURTHER SURFING

http://cogen.unep.org/ – 'Cogeneration for Africa' is an innovative and first-of-its-kind clean energy regional initiative, funded by the Global Environment Facility.

http://earthtrends.wri.org/ – EarthTrends is a comprehensive online database, maintained by the World Resources Institute that focuses on the environmental, social, and economic trends that shape our world.

http://solar.coolerplanet.com – Cooler Planet is a business dedicated to helping consumers and small business owners reduce their carbon footprints, and help limit global climate change.

http://theenergycollective.com – Power, Policy, Climate: a place where conversation happens.

www.ashdenawards.org/ – Inspiring sustainable energy solutions.

www.chathamhouse.org.uk/ – Chatham House's mission is to be a world-leading source of independent analysis, informed debate, and influential ideas on how to build a prosperous and secure world for all.

www.japanfs.org/en/ – Japan for Sustainability is a non-profit communication platform to disseminate environmental information from Japan to the world.

www.ren21.net/map – A map containing a wealth of information on renewable energy including support policies, expansion targets, current shares, installed capacity, current production, future scenarios, and policy pledges.

www.RenewableEnergyWorld.com – Source for renewable energy news and information.

www.wind-works.org/ – An on-line archive of articles and commentary primarily on wind energy, Feed-in Tariffs, and Advanced Renewable Tariffs.

www.worldenergy.org/ – The World Energy Council is the "foremost multi-energy organization in the world today".

MakingIt
Industry for Development

A quarterly magazine aiming to stimulate debate about global industrial development issues

UNITED NATIONS
INDUSTRIAL DEVELOPMENT ORGANIZATION