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DECEMBER 1-15, 2008

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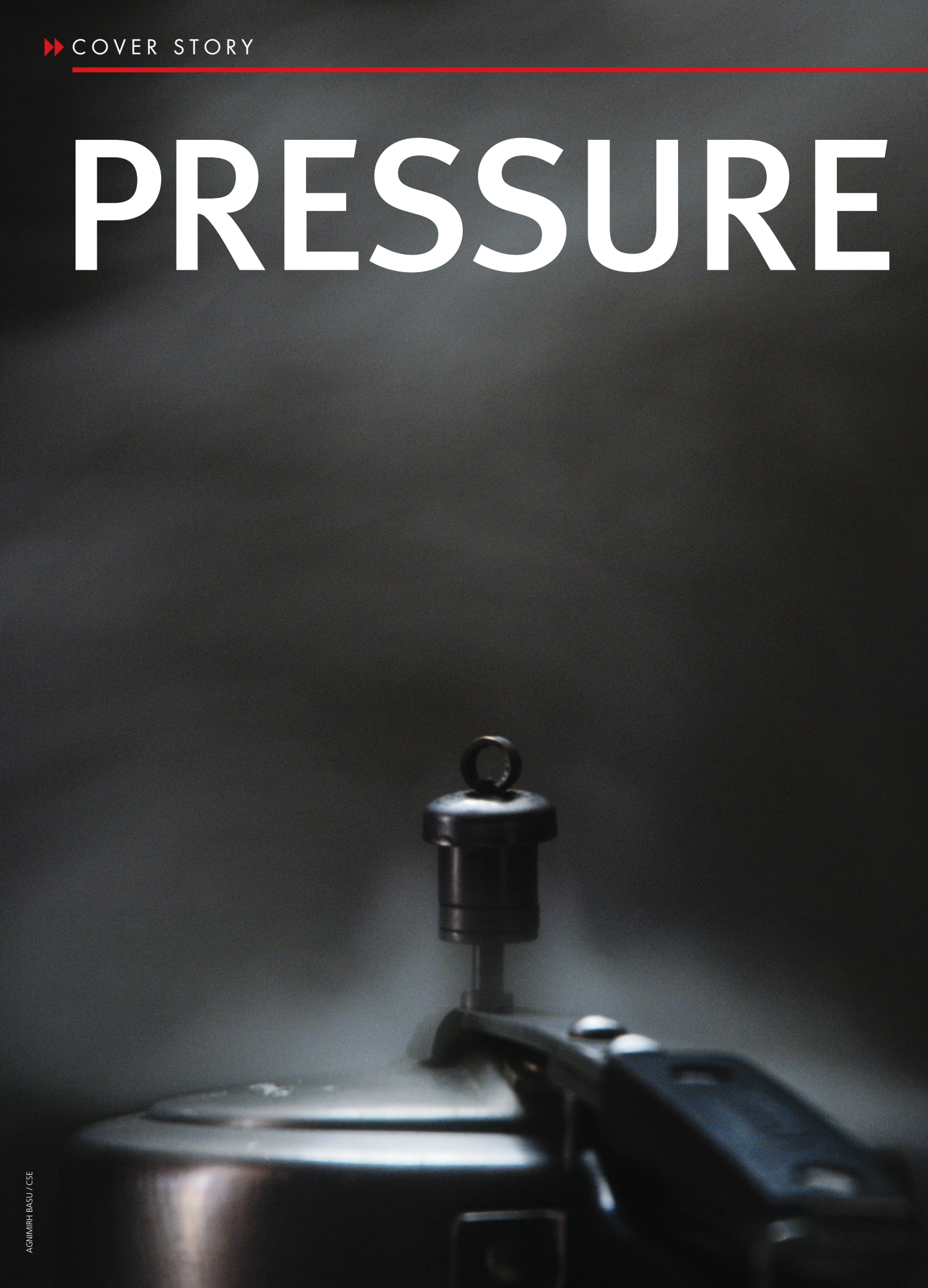


AGNIMIRH BASU / CSE

POINT

At the climate change conference in Poznan, Poland, the world could get cooked, for good

A curtain raiser on the climate negotiations in Poznan.
By Chandra Bhushan, Mario D'Souza, Sunita Narain, Pratap Pandey, Pradip Saha and Kushal Pal Singh Yadav

The 14th Conference of Parties (COP) to the United Nation Framework Convention on Climate Change (UNFCCC), to be held December 1-12, 2008 at Poznan in Poland, is a little different from all the COPs held so far in the 21st century. For the first time since the December 1997 COP held in Japan, when the world agreed to the now well-known Kyoto Protocol, which legally binds the industrialized world to cutting emissions, the world is moving to a negotiating mode.

This is because, last year, at COP-13 held in Bali, Indonesia, nations decided upon a course of action called the Bali Action Plan, 'a comprehensive process to enable the full, effective and sustained implementation of the Convention'. By the end of next year, at the COP to be held at Copenhagen, Denmark, nations have to finalise how they will tackle climate change 'now, up to and beyond 2012'. The Poznan COP is therefore finely, even dangerously, poised. Given that the warming of the climate system is unequivocal, as the Bali Action Plan places on record, the question is the speed with which countries are prepared to move, particularly as they need to take on deep and drastic emission reduction targets to avert the worst excesses of a changing climate.

It is for this reason the action plan records the need to "urgently enhance" the way the UNFCCC is being implemented; the multilateral agreement will achieve its objective of stabilising climate change only if there are "deep cuts" in global emissions, but are countries willing?

With Earth's future literally at stake, the period from the COP at Bali to the one at Poznan has merely seen a flurry of proposals. Over 4 preparatory sessions, there has gathered an immense wish-list of what can, could or should be done, or not, but no basis for negotiation (no text, however provisional, or bracketed). The Bali Action Plan itself was a wish-list, a pure exercise in procrastination. No deep targets were set for developed countries to cut emissions. Instead in Bali, the industrialized countries managed to sneak in the provision that their action to cut emissions may not be based on hard commitments or mandatory targets and compliance within a multilateral framework, but actions that are merely measurable, reportable and verifiable (see: *Down To Earth*, January 15, 2008).

The Bali Action Plan eroded trust among developed and developing nations. As 2008 has progressed, the rift has grown. Age-old dissensions have come to the fore. The US is still pointing a finger at China, India, Brazil and South Africa, saying if these countries do not take action, it will not. Thus deflecting attention from the fact that its emissions, already one-fourth of the world's total emissions, have increased, and that it wants allowance to let its emissions peak after 2025, ten years after the least risky target for global emissions to peak and then decline. At the preparatory meeting in Accra, Ghana, the European Union (EU) threw in its tactical missive—to differentiate between developing countries—advanced developing countries, major economies and other developing countries—so that it could segment the group and carve it up to get emission reduction targets from some. Japan has jumped with a plan to have sectoral emission reductions so that engagement becomes mandatory.

The Bali Action Plan eroded trust between developed and developing countries

As emissions of the developed world have actually increased (not decreased) during the last decade or so, there is also much afoot to juggle the targets. Some countries have said (informally) that the base-year should change—from 1990 to 2000 or even later. As emissions have soared in this period—since 1990-2005, US CO_2 emissions have increased 20 per cent, Japan 13 per cent, and Australia over 35 per cent—it would be a convenient write-off. If this happens, reduction targets would be from a higher baseline and much would be forgiven and forgotten.

Another jugglery is to postpone the emission reduction targets so that they mean little. In other words, extend forgiveness into the future. When negotiators met mid-2008 at Seoul, South Korea to discuss the question of future targets, the US and Japan resisted interim targets for 2020. At the Hokkaido, Japan G 8+5 meet, the G-8 agreed on 50 per cent cuts by 2050, without saying what would be required to be cut by 2020 and of course, without any mention of a baseline year for the cuts (see: *Down To Earth* July 16-31, 2008).

In addition, there is the delicate matter of emission reductions, which are being credited using the land use, land use changes and forestry, in the developed world. This sector, known as LULUCF, has been widely considered to be one of the 'loopholes' in Kyoto, given methodologies for estimating emission reduction from this sector are not well established. Now, there is a move (to be watched in Poznan) to widen the holes, not to plug them. Canada—a major emitter in the past years—has suggested approaches to "substantially improve incentives" for mitigation from this sector. But more specifically, these call for including new sinks—harvested wood products and wetland restoration—to get some pass marks in the much-in-red balance sheet.

Climate change is urgent. The only chance is to avert catastrophe. Can we? Do we have a choice?

In all this, the developing world is caught in the ultimate pincer attack. On the one hand, it needs to increase emissions for its development. Much is being made of China's emissions, which totals or exceeds the US' today. Not much is being said about how the UNFCCC was for the developed countries to reduce their emissions, precisely to give China and others the space to increase. On the other hand, they are beginning to feel the devastating impact of changing climates—from increased intensities of rainfall to cyclonic events. They are victims, but they are being made to be the culprits.

In Bali these countries, under pressure, agreed to take nationally appropriate mitigation actions, even if it meant deviating from the basic tenet of the UNFCCC, which only required the industrialized world to cut emissions. But it was also agreed these mitigation actions would be supported and enabled by technology, finance and capacity building, in a measurable, reportable and verifiable manner.

This is where the stalemate is complete. There is virtually no movement on how the funds or technologies needed for this transition will be paid for. In preparation for Poznan, country positions on these two issues are predictable and deadlocked—the developing countries want to be assured finances, substantial and assured. The developed world is saying little and putting even less real change on the table.

But it is in the funding of adaptation—everything that can be done to increase the resilience of the poor and help to 'adapt' somehow to the devastation—that pettiness comes into its own best. The developing world wants urgent and big action to respond to the challenge of adaptation. The developed world agrees, but does not want to commit money and be tied into any real financial commitments.

The only area where there seems to be the beginning of some understanding is the need to pay for standing forests in developing countries. The 4th Assessment Report of the Intergovernmental Panel on Climate Change estimates 20 per cent emissions are contributed from deforestation and forest degradation in the developing world. These emissions need to be 'mitigated' and, simultaneously, everything done to ensure more forests are not cut, because countries have no option but to use their lands for agriculture or for mining. So, standing forests are carbon stocks and should be paid for. But even as this issue is inching towards consensus, there are big issues at stake here. Forests are not just carbon stocks but livelihoods and habitats of millions of people. How will their rights and uses be protected? What is the 'price' that can be put on the forests, without compromising the interests of the poorest in the world? Indeed, how can the mechanism work for the poor?

There are huge issues of how the emissions will be calculated and verified especially given the past failures of the global community, in designing instruments that can work effectively and easily. The Clean Development Mechanism (CDM)is now widely accepted as being complicated, designed for cheap reductions and built on the worst principles of the now-collapsed market. CDM consultants that assess and rate the project are paid by the project proponents and little is done to make sure that the 'fundamentals' of this carbon market are not compromised. Instead it has become nothing more than creative carbon accounting, with little big ticket change. The atmosphere at Poznan, therefore, will be murky and combative.

Poznan marks also a difference in our time. The US election has brought in a new president, who has said that he will get his recalcitrant and renegade country to take on emission cuts. At a recent meeting, president-elect Barack Obama has said he will bring US emissions down to 1990 levels by 2020. That still means no drastic emission cuts—something desperately needed—but is more than what the world has got from the US till date. But this is also when the world is facing a recession. On the one hand, the r-word may bring some relief to climate change targets as countries cut fossil fuel use; it also brings the opportunity to use the massive public spending on building a new and different economy (see editors). But the reality is that it may also bring out even more of the worst, increase the rich world's unwillingness to pay for its excesses and to pay for ways to 'avoid' emissions in the emerging world.

This is also when the time for postponement is over. Climate change is real and urgent. The only chance is to avert a catastrophe. Can we? Do we have a choice?

WHAT'S ON THE TABLE

The Bali Action Plan requires deliberation on a number of issues, under the Ad Hoc Working Group on Long-term Cooperative Action (AWG-LCA)

SHARED VISION

Bali Action Plan 1a: Countries must address the question of 'a shared vision for long-term cooperative action, including a long-term global goal for emission reductions, to achieve the ultimate objective of the Convention, in accordance with the provisions and principles of the Convention, in particular the principle of common but differentiated responsibilities and respective capabilities, and taking into account social and economic conditions and other relevant factors'.

In terms of what the 'shared vision' should be, developing countries such as China and Brazil stand firmly by the UNFCCC; such a vision can only be guided by the principle of 'common but differentiated responsibilities', so maintaining the legal distinction between Annex I and non-Annex I countries.

Japan, echoing what many developed countries want, wishes to abolish this distinction. It wants a new protocol beyond 2012 or an amended Kyoto Protocol so that all countries take responsible actions. The definition of Annex I countries should be changed based on GDP, per capita emissions, cumulative emissions or future emissions. It further wants to differentiate within developing countries, creating segments, of those who must act now; those who can act later.

In terms of stabilising emissions, there is consensus that the long-term goal is emission reduction by 2050. But there is clear division, and much animosity, about what happens in the interim. Developing countries are united in demanding Annex-1 countries must take on mid-term emission reduction targets, a 25-40 per cent reduction by 2020 (India says 'more than 25-40 per cent') from the 1990 baseline. Japan, contrarily, believes all parties 'should adopt the long-term goal of achieving at least 50% reduction of global emissions of greenhouse gases (GHG) by 2050'; crucially, it does not suggest a base year. The EU concurs, except that it politely inserts 1990 as the base year; it is even willing to undertake 'clear mid-term targets', provided there are 'fair contributions from all Parties'.

'Equity must be central to the way forward', India believes. 'This requires that any stabilization target should be achieved on the basis of the principle that each human being has an equal right to the common atmospheric resource, accounting also for the historical responsibility of developed countries in building the concentration of greenhouse gases in the atmosphere'. The international community must, therefore, agree to an'equitable sharing of carbon space'. India feels a paradigm of convergence of per-capita emissions of developing and developed countries, also accounting for the historical responsibility of developed countries, provides an equitable approach to fair burden sharing.

MITIGATION

Bali Action Plan 1 b: Countries must tackle the question of 'enhanced national/international action on mitigation of climate change'.

The politics here turns on the strong Annex I push to make developing countries, take on mitigation commitments. Developing countries, using the text of the UNFCCC, say they do not need to.

Country stances turn shrill when clarifying what they wish to do to mitigate climate change. The US, for instance, wants to redefine the 'common' in 'common but differentiated responsibilities' in the context of mitigation. It wants to redefine 'developed' and 'developing' countries based on economic and emission trends, and that all countries should put forward their actions in a 'measurable, reportable and verifiable' manner. Moreover, referring to the nature of national mitigation commitments and actions by developed countries, the US suggests applying the same 'character' of various countries' efforts (legally binding or voluntary) to all countries. Its wish is clearly to cancel out, in one diplomatic stroke, any scope of difference between countries.

Similarly, although not using the same language, the EU wants developing countries 'as a group' to take on commitments; it also wants to 'differentiate' among developing countries, based on level of development, to assign different levels of mitigation targets. It wishes more advanced developing countries contribute adequately, a word open to interpretation, according to their responsibilities and respective capabilities. Japan goes further, creating three categories of developing countries.

Country stances turn shrill when clarifying what they wish to do to mitigate climate change

The G-77 bloc of developing countries has equally sharp counter-proposals. China warns that 'the principle of "common but differentiated responsibilities" between developed and developing countries is the keystone of the Convention and the Bali Action Plan. Any further sub-categorization of developing countries runs against the

Convention itself and is not in conformity with the consensus reached in the Bali Action Plan'.

SECTORS

Bali Action Plan 1 b (iv) : Cooperative sectoral approaches and sector-specific actions, in order to enhance implementation of Article 4, paragraph 1 (c), of the Convention'

The most contentious matter within the larger rubric of mitigation, this is seen by developing countries as a convenient ploy to get sectoral commitments, which will then bind their industries to emission cuts. Norway has suggested continuing negotiations on how to include more sectors and even establish independent legally binding agreements covering some sectors. Australia endorses this, calling for establishing binding actions based on sectoral approaches for developing countries. The EU wants coverage to extend 'to all sectors' in 'countries with high capability' (read: India, China, Brazil, South Africa). The real politics here lies in the attempts of developed countries to push for global sectoral standards, and use these to dilute its requirements of technology transfer. China clearly warns them not to do so: 'the aim of cooperative sectoral approaches and sector-specific actions is to enhance cooperation between Parties at sectoral level for the purpose of promoting development, deployment, diffusion and transfer of GHG emissions control technologies, practices and processes. Any twist of this understanding or discussion under the AWG-LCA leading to global sectoral standards, benchmarks or emission reduction targets is not acceptable'.

ADAPTATION

Bali Action Plan 1 (c): Countries must deliberate upon 'enhanced action on adaptation'.

In 2001, the Marrakesh accord, the outcome of COP 7, stressed the need for predictable and adequate levels of funding for parties not included in Annex 1 and the need to develop appropriate modalities for burden sharing among parties included in Annex II. Three new funds were established; 18 areas of assistance on adaptation were identified, including for GEF funding and developing National Adaptation Porgrammes for Action (NAPAs) for least developed countries. The adaptation fund was finally operationalised in Bali, where an adaptation fund board was set up, serviced by a secretariat (GEF) and a trustee (World Bank), on an interim basis.

Sectoral wish-list

Sectors mentioned by parties include:

- Energy or power generation (Bangladesh, MISC 1; Korea, sectoral approaches workshop); coal-fired power generation (Japan, MISC.4 and MISC 5; Alliance of Small Island States, called AOSIS (sectoral approaches workshop); energy efficiency (India, sectoral approaches workshop);
- Iron and steel (Japan, MISC 4 and MISC 5; Republic of Korea, sectoral approaches workshop);
- Cement (Japan, MISC 4 and MISC 5; AOSIS, Republic of Korea, sectoral approaches workshop);
- Residential/commercial (Japan, MISC 5);
- Aluminium (Japan, MISC 4, MISC 5; Korea, sectoral approaches workshop);
- Transport (Bangladesh, MISC 1); road transport (Japan, MISC 4 and MISC 5; AOSIS, sectoral approaches workshop);
- Chemical industry (Republic of Korea, sectoral approaches workshop);
- Pulp and paper (Republic of Korea, sectoral approaches workshop);
- Forestry (Bangladesh, MISC 1); Land Use, Land Use Change and Forestry (Japan, MISC 5);
- Agriculture (Japan, New Zealand, MISC 5);
- Waste (Japan, MISC 5).

The ploy to get sectoral commitments from the developing world is most contentious

While all agree on the need for adaptation measures, differences appear among countries on two counts: a) the question of responsibility and b) where the money is to come from. The Alliance of Small island States suggests a Convention Adaptation Fund, linked to GHG emissions and based on the polluter pays principle (thus, responsibility falls upon developed countries); also, there should be an international insurance mechanism. G-77 and China want the financing to be 'predictable and stable, new and additional, adequate and timely'; India adds the element of 'automaticity' should also guide how money is generated for adaptation.

Striking a different note, the EU says effective action on adaptation is the responsibility of every country; it proposes a broad funding architecture that can leverage private and public financial flows. The US does not think an intergovernmental insurance mechanism is a good idea.

The Swiss government has proposed a fund for adaptation, based on a global burden sharing system. The funds would be raised, using the polluter pays principle, through a global levy of US $2 per tonne of CO_2 on all fossil fuel emissions—roughly a burden of US $0.5 cents/litre of liquid fuel. The uniform and global tax reflects the need to address the problem on a global scale, says the proposal.

But to take into account the principle of common but differentiated responsibiities, a basic tax exemption of 1.5 tonnes of CO_2 per inhabitant would be given. The estimated revenues, amounting to US $18.4 billion, would be allocated to a multilateral adaptation fund.

TECHNOLOGY

Bali Action Plan 1 (d): Countries must negotiate the question of 'enhanced action on technology

development and transfer to support action on mitigation and adaptation'

This is a highly divided terrain. The G-77 countries want to create an instutional arrangement to facilitate technology transfer and development under the rubric of UNFCCC. China calls it the Multilateral technology Acquisition Fund; India calls it the Multilateral Climate Technology Fund—that is, financed by the developed world. By contrast, the EU and the US suggest the scope of the issue goes beyond the UNFCCC, and demand efforts taken outside be recognised. The US believes new institutions under the UNFCCC are not required; the EU is all for 'voluntary cooperative technology-oriented agreements'. Smelling an opportunity to push its Cool Earth programme (a technology roadmap for 21 innovative technologies), Japan is enthusiastic about the issue, but has a devastating rider: to support actions by developing countries, it wants 'sectoral sub-groups with the participation of private sectors'.

It is clear that negotiations will revolve around the visible reluctance of the developed world to share technology via transfer. This attitude is most visible in the differing vocabulary used: the EU, for instance, wishes technology transfer to be limited to 'research, development and demonstration'; India, for instance, also wants 'manufacture, commercialization, deployment and diffusion' of technologies.

It is also clear that the question of intellectual property rights (IPR) related to environmentally sound technologies (ESTs) will be debated; as always, without agreement. While China, for instance, clearly states the current IPR regime does not match the need to transfer technologies, specifically ESTs, the US wants developing countries to create 'an enabling atmosphere to attract private funds for ESTs'. It also expects major emerging economies to improve technologies 'through their own policies and resources'. Thus, while China and other developing countries want innovative IPR sharing arrangements to jointly develop ESTs, or criteria for compulsory licensing for patented ESTs, the US wants IPR enforcement and protection and the promotion of competitive and open markets for ESTs.

Negotiations will revolve around the visible reluctance of the developed world to share technology

On characterizing

the provision of new and additional resources, Parties proposed:

- **New** (EC and its member states, MISC 2) and additional, that is, **over and above the target of 0.7 GNP for Official Development Assistance** (ODA) (Colombia, MISC 1; Singapore, MISC 2; AOSIS (Alliance of Small Island States), G77 and China, African Group, MISC 2/Add 1; Argentina, Brazil, China, MISC 5; LDCs, finance workshop);
- **Adequate** (EC and member states, Singapore, MISC 2; AOSIS, G77 and China, MISC 2/Add 1, China, MISC 5; LDCs, finance workshop);
- **Measurable, reportable and verifiable** (Saudi Arabia, MISC.1; Australia, G77 and China, MISC 2/Add 1) with clear targets and timelines (Gambia, adaptation workshop);
- **Predictable** (EC, member states, Singapore, MISC 2; AOSIS, G77 and China, MISC 2/Add 1; Brazil, China, Norway, MISC 5; LDCs, finance workshop);
- **Reliable** (Norway, MISC 5);
- **Stable** (G77 and China, MISC 2/Add 1; AOSIS technology workshop);
- **Sustainable** (EC and member states, Singapore, MISC 2);
- **Timely** (AOSIS, G77 and China, MISC 2/Add 1);
- **Inclusive, financially feasible**, and able to broaden the scale of mitigation and adaptation activities (Mexico, MISC 2);
- **Coherent, flexible**, and able to mobilize all sources of finance (South Africa, MISC 5).

FINANCE

Bali Action Plan 1 (e): Countries must consider 'enhanced action on the provision of financial resources and investment to support action on mitigation and adaptation and technology co-operation'.

Mexico's proposal, in this context, is indicative of what developing countries want. The proposal moots a World Climate Change Fund (Green Fund) as a financial scheme that complements existing mechanisms. All countries could contribute to the fund in accordance with the principle of common but differentiated responsibilities and respective capabilities.

The proposal provides a way to tackle the question of historical and cumulative effects. Importantly, it brings up the question of equity.

Not only total emissions but per capita emissions, the proposal clarifies, should be taken into account and there must be a progressive convergence of per capita emissions. There should also be a distinction between emissions for basic needs and emissions in countries with a much greater level of development. 'There should also be a sharing of the terrestrial and marine sinks, so that every person on Earth can benefit equally from this environmental service'. Catholic in its breadth, the proposal suggests 'In principle, all countries, developed or developing, would benefit from the fund'.

Like Mexico, G-77 is united in its demand for a funding mechanism within the scope of the UNFCCC. The EU differs, suggesting a 'toolbox' to deliver finances, that contains already existing channels of financing also outside the treaty. As with the question of technology transfer, the US does not agree in creating a new institution under the UNFCCC, foregrounding its partnerships outside the ambit of the treaty as proof of its generosity.

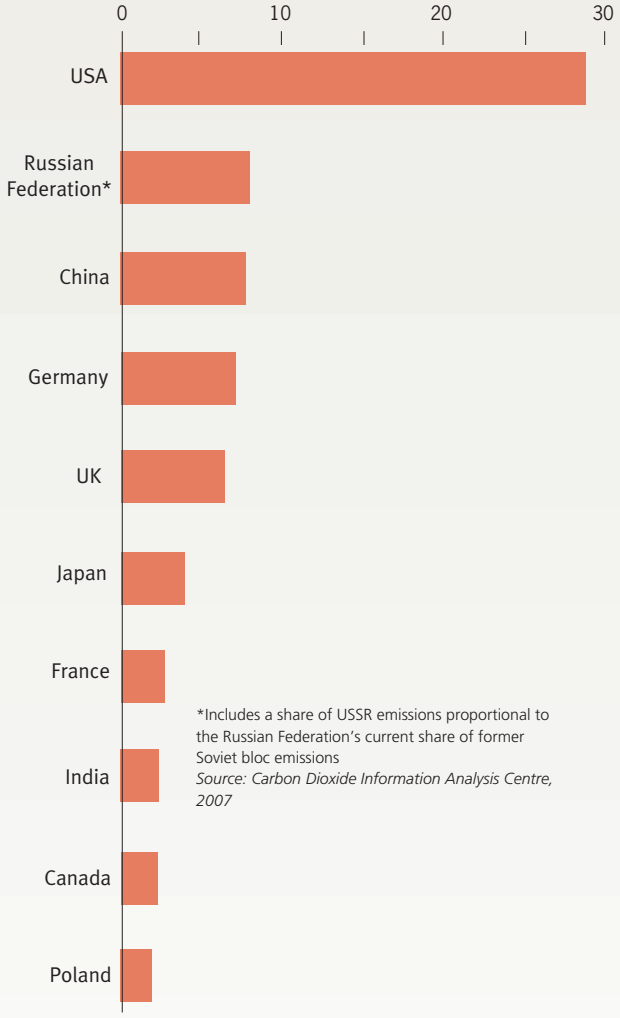
The question now is: where will the deliberations in Poznan lead? The road to Copenhagen is just 12 months away and, already, it seems paved with dollops and dollops of procrastination. ■

WHAT THE RICH DID

Historical burden

Share of global CO_2 emissions, 1840-2006 (per cent)

Climate change is about cumulative historical emissions—a tonne of CO_2 released in 1850 is equal to a tonne of CO_2 released today. Rich countries account for about seven out of every 10 tonnes of CO_2 that have been emitted since the start of the industrial era. Historical emissions amount to about 1,100 tonnes of CO_2 per capita for the UK and the US, compared with 66 tonnes per capita for China and 23 tonnes per capita for India



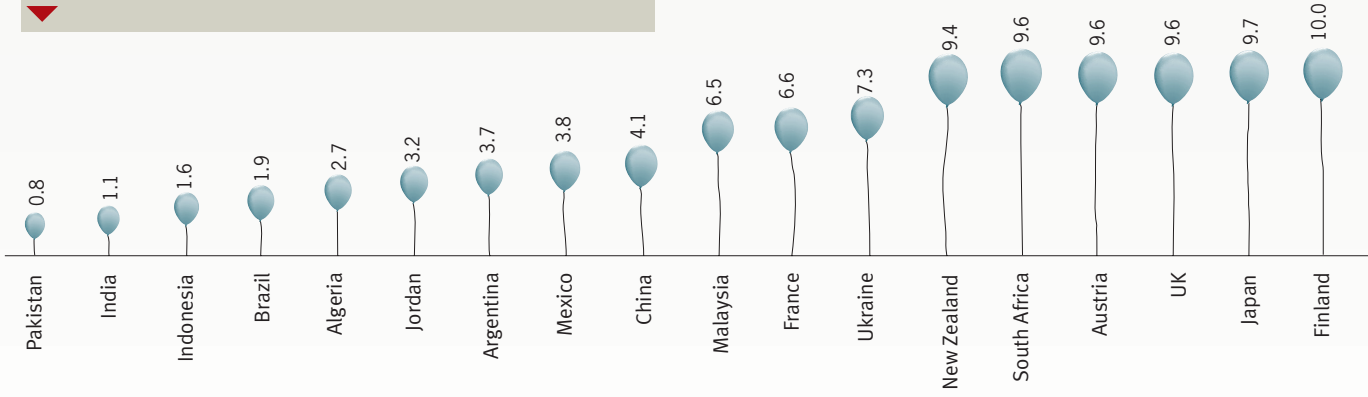
*Includes a share of USSR emissions proportional to the Russian Federation's current share of former Soviet bloc emissions

Source: Carbon Dioxide Information Analysis Centre, 2007

Per capita CO_2 emissions, 2005

While China may be about to overtake the US as the world's largest emitter of CO_2, its per capita emissions are just one-fifth that of the US.

Emissions from India are increasing. Even so, its per capita carbon footprint is less than one-tenth of that in high-income countries. The per capita increase for Canada since 1990 (five tonnes) is higher than per capita emissions of China in 2005 (4.1 tonnes)



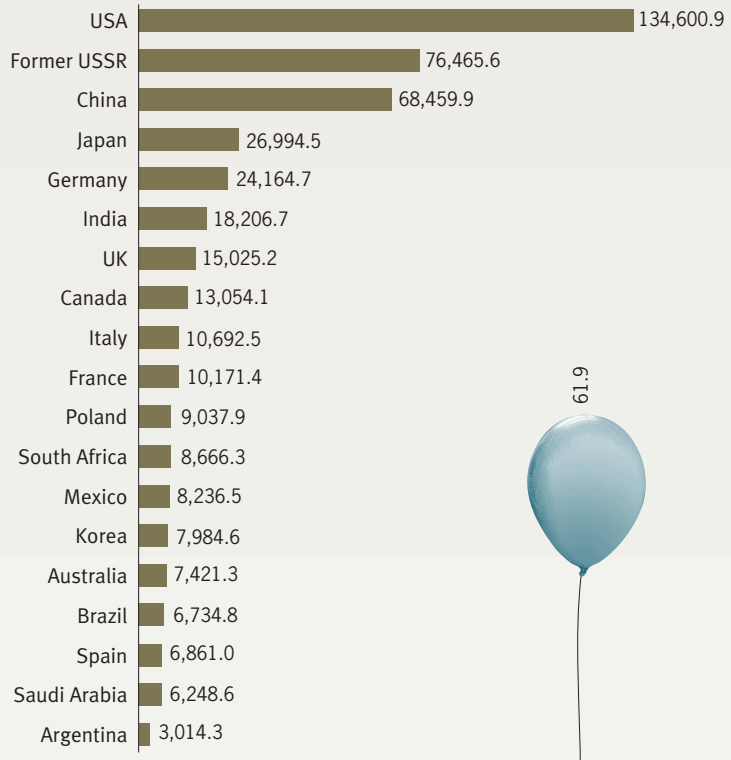
Source: US Department of Energy, 2007

Cumulative emissions: 1980-2005

(million tonnes of CO_2)

Rich countries are still the major emitters of total CO_2. Between 1980 and 2005, the total emissions of the US were almost double that of China and more than seven times that of India.

The current emissions from developed countries are still very high: with just 15 per cent of the world population, they account for 45 per cent of CO_2 emissions

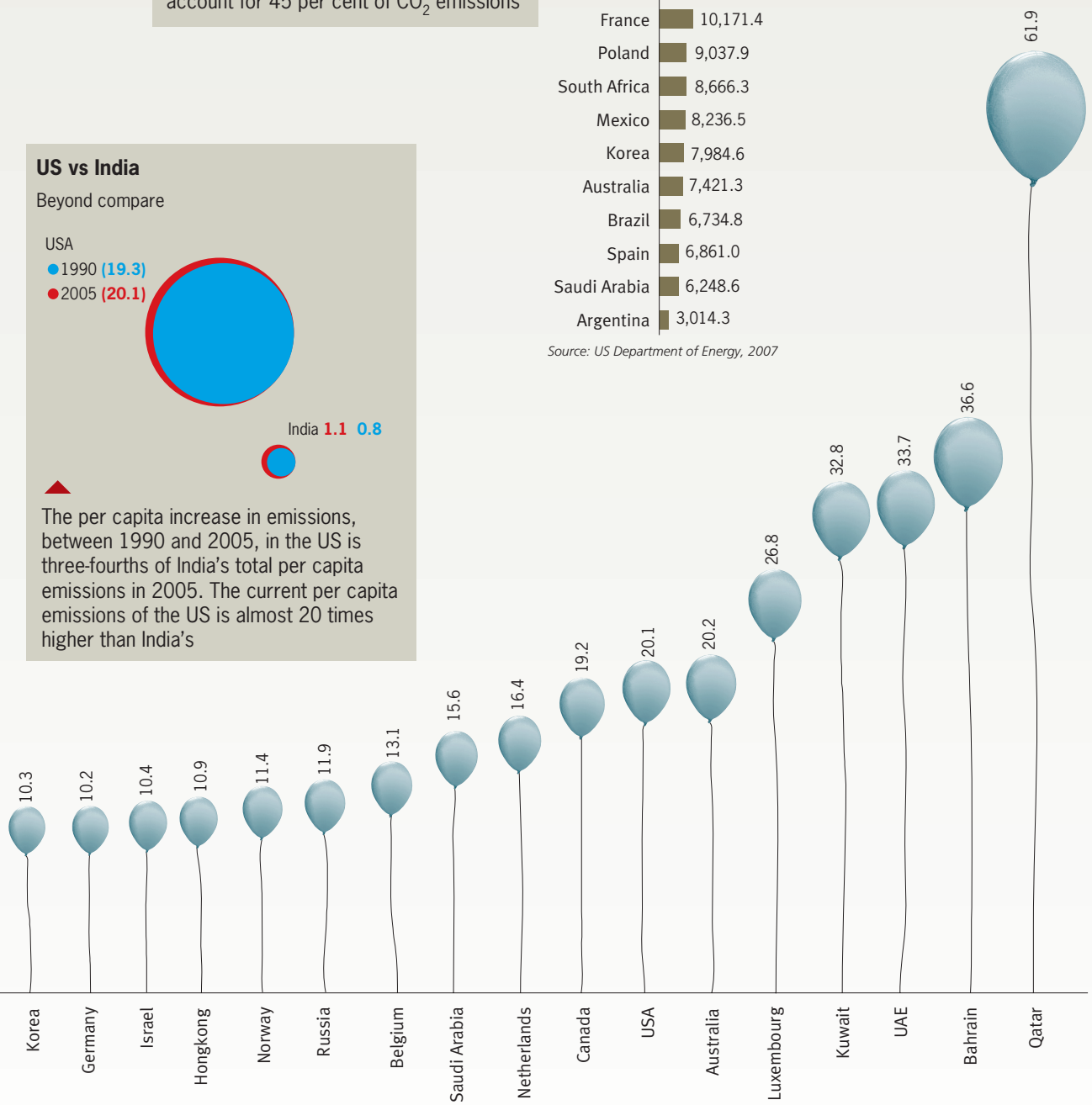


Source: US Department of Energy, 2007

US vs India

Beyond compare

The per capita increase in emissions, between 1990 and 2005, in the US is three-fourths of India's total per capita emissions in 2005. The current per capita emissions of the US is almost 20 times higher than India's



EQUITY FOR ALL

Climate change is linked to emissions, in turn to economic growth. Limiting emissions is then about limiting growth. Thus, sharing growth between nations has been the main bugbear. The UN Framework Convention on Climate Change expressed the principle of equity by enjoining countries to take action based on common but differentiated responsibilities and respective capabilities.

Today, seriously constrained by the amount of emissions it can put out in the atmosphere, governments of the rich world would like to rewrite the principle of burden sharing agreed in Rio. But civil society groups are proposing alternatives, which need to be considered and examined

The fourth assessment report of the Intergovernmental Panel on Climate Change says that to avoid serious ecological and economic damage, the global temperature should not exceed 2°C from the pre-industrial level—it has already increased 0.74°C. This in turn needs CO_2 concentration not to exceed 350-400 parts per million (ppm). But this touched 379 ppm in 2005. If the world is to remain within the 2°C target, there is limited scope for future emissions.

The global budget is extremely tight. The question is how to share it. Over the years, different proposals have been presented. These have been based either on current and future emissions or historical emission burdens of different nations.

Current and future emissions

Three methods have been proposed under this approach:

- **The sinks approach** requires that the world not emit more than what the sinks can absorb. In 1991, the Delhi-based Centre for Science and Environment (CSE) proposed the concept of equal per capita entitlement based on available sinks on land and in oceans. Those on land are national property, but the oceans, which absorb around two billion tonnes of carbon (tC) each year, are global commons to which all people have an equal entitlement. Once entitlements are defined, low-level polluters would have an incentive to keep their emissions growth path low: trade unused emissions rights to high-level polluters.
- **The budget approach** requires an upper limit of CO_2 concentration in the atmosphere, and sets down the year by which this limit must be reached. This gives a budget of total emissions to be distributed equitably among nations on per capita basis. A country not using its quota in a given year can trade it.
- **The convergence approach** agrees on a per capita emission level to meet the 2°C target. This would provide each person about two tonnes of CO_2 (tCO_2) per year. Countries above this limit would have to cut emissions, while those below it would have the opportunity to increase emissions.

Historical emissions approach

While it industrialized over the past 150 years, the developed world emitted much more greenhouse gases (GHGS) than developing countries. This historical inequity can be accounted for in a number of ways to create equal entitlements.

- In 1989, the International Project for Sustainable Energy Paths proposed that if the climate system was to remain stable, the world could emit no more than 428 billion tC between 1950 and 2100. Nations would share this budget on a per capita basis over the same period. If developing countries continued to emit CO_2 at their 1986 rate, the project said, their quota would not get over till 2241. Developed nations had already used their quota by 1986.
- A few months before the 1997 Kyoto agreement, Brazil proposed that emissions targets be determined on the basis of contribution to temperature increase up to 1990. This put the focus on industrialized countries; while they were responsible for 75 per cent of the total emissions, their share for temperature increase was 88 per cent. The proposal required that countries falling short of their targets be fined US $3.33 for each extra emission unit. The money thus accrued would go into a fund to finance mitigation and adaptation projects in developing countries.
- In 1990, Kirk Smith formerly of the University of California's School of Public Health introduced the concept of natural debt, which accounted for cumulative emissions of each country from 1950. Just as there are economic disruptions when the financial debt grows too large, there will be ecological disruptions if the natural debt is too large, Smith argued. He showed the industrialized countries to be the largest natural debtors. He also showed that the international press's current villains,

DIVYA

India and China, will take decades to match the US in terms of natural debt. For instance, by 2025, India's natural debt will be five times less than that of the US.

RECENT MOVES

With the issue of burden sharing being debated for a post-2012 agreement, new frameworks have been proposed by civil society groups

Cap and share

The model, proposed earlier this year by the Ireland-based Foundation for the Economics of Sustainability, requires that the world first agree to a maximum emissions level from burning fossil fuels. Once the emissions cap is fixed, emission levels for a year would be shared equally among the global adult population. Each individual would receive a pollution authorization permit which could be sold at market rates. Fossil fuel companies could buy permits from financial institutions to cover emissions from their products.

The amount of permissible emissions would be lowered each year so that it was under levels that could destabilize the climate. A yearly reduction of emission allowances would increase the market value of permits, raising incomes of the poor—who emit less—and enabling them to buy expensive food and fuel. Its proponents say that the cap-and-share model offers an orderly market-based path to manage the transition from fossil fuels to alternative energy. The drawback of this approach is that it does not account for historical emissions.

Greenhouse Development Rights

The Greenhouse Development Rights (GDR) framework, proposed by Paul Baer and Tom Athanasiou of EcoEquity and Sivan Kartha of the Stockholm Environment Institute tries to answer the oft-repeated criticism about inequity in emission within the developing world. It incorporates the rich, even in the developing world, to share the burden of reducing emission by 80 per cent from 1990 levels by 2050.

To fix responsibility for the climate problem and also ascertain the capacities of nations to pay for a solution, GDR divides countries into two groups based on income. People below a certain income level—the development threshold—are absolved of responsibility, and not required to bear costs. GDR sets US $9,000 per year (in terms of purchasing power parity, PPP) as the development threshold. Those above this threshold are assumed to have realized their right to development and expected to pay for climate mitigation. To determine how many people have to pay and how much, GDR introduces two concepts: responsibility and capacity index.

The capacity 'C' of a country is the sum of all individual incomes above the development threshold. For example, let's assume that in a country 10 per cent people have yearly incomes above US $9,000. In that case, the individual incomes of this group above the threshold are added up to arrive at the country's capacity index.

Responsibility index 'R' is calculated as the total of a country's cumulative per capita CO_2 emissions from fossil fuel consumption since 1990, above the developmental threshold.

GDR deems emissions related to the share of income below the development threshold—equivalent to the part of national income that is not considered in calculating a country's capacity—as survival emissions. Emissions linked to income above the development threshold are luxury emissions and they have to be accounted as country's responsibility.

GDR then combines these two concepts to calculate a Responsibility and Capacity Indicator (RCI), which assigns each country its share of the mitigation and adaptation costs. According to the method, the US must shoulder a little more than a third of the global costs and the EU roughly, a quarter. China's share is less than one-fifteenth while India's is less than one three-hundredth.

Under GDR, all Americans earning more than US $9,000 will on an average pay US $780 annually to mitigate and adapt to climate change. The burden on Indians in the same bracket will be US $51 and for China US $142 (see table: *GDR burden sharing proposal,* p38).

GDR unpacked

There is nothing wrong in asking the rich in the developing world to pay for emissions reductions; in fact national governments should tax the rich and use the money to invest in clean energy and technology. But this should be part of national agendas and not international burden sharing arrangement.

There is also a problem when 'survival emissions' entitlement of a rich country is far higher than that of a poor country and survival emission entitlement of a polluting country is far higher than a clean one. For example, consider India and the US. India's per capita income in 2005 was US $3,452 (PPP adjusted) while its cumulative per capita CO_2 emissions between 1900 and 2005 was 3.5 tC. So the survival emissions at the threshold of US $9,000 (PPP) is calculated to be 9.1 tC for India. The US, with per capita income of US $41,565, and per capita CO_2 emissions of 80.4 tC, is entitled a survival emission of 17.4 tC. So, for the same development threshold, an American gets a higher emission entitlement (17.4 tC) than an Indian (9.1 tC). Any emission above 9.1 tC in India will be taxed, whereas this level is 17.4 tC for the US.

The survival emission allocation for developed countries is far higher under GDR than the developing

GDR burden sharing proposal

The US will have to bear more than one-third of the global mitigation and adaptation costs under GDR

Country	Per capita income in 2005 (US $PPP)	Share of global population (%)	Population above development threshold (%)	Cumulative per capita CO_2 emissions for 1990-2005 (tonne of carbon)	Share of global RCI (%)	If total mitigation and adaptation costs are 1% of gross world product annually	
						Total bill per year (billion US $PPP adjusted)	Average 'taxpayer' bill (US $PPP per person)
Australia	33,993	0.32	98.7	69.7	1.8		2103
Brazil	8,587	2.9	27.6	7.1	1.6	10	193
China	6,920	20.39	23.2	10.7	7.0	43	142
Germany	29,980	1.28	96.7	46.5	5.5	34	428
India	3,452	17.02	3.8	3.5	0.3	2.1	51
Japan	30,736	1.99	96.6	38.5	8.1		1504
South Africa	11,187	0.73	36.1	33.8	1.1	6.5	382
UK	33,175	0.94	95.7	41.5	4.3	26	458
USA	41,565	4.67	90.5	80.4	34.3	212	780

Note: A "taxpayer" is defined as a resident with an income above the development threshold. All figures 2005 US dollars, PPP-adjusted; *Source: Greenhouse Development Rights, 2007*

Countries that have a large majority below the development threshold stand to lose their emission entitlement compared to richer nations. For example, in India more than 95 per cent of the population falls below the development threshold of US $9,000. This implies the emission entitlement of most Indians is equal only to their current emissions level. In contrast, 90 per cent of Americans are above the development threshold, and get an emission entitlement corresponding to the threshold emission level.

In this sense, the GDR framework deprives most Indians of their basic development entitlement.

The other problem with GDR is that it seems to reward historical and heavy polluters. By taking historical emissions from 1990—and not 1950 or even beyond, for which we now have robust data—GDR dilutes the 'polluters pay' principle. To say that emissions before 1990 "were usually (though not always) made in ignorance", misses the moral point that people have benefited from the actions of their ancestors in overdrawing environmental assimilative capacity. The current standard of living in the developed world would not be as high today if previous generations had directed more resources to GHG reductions. If the present generation has acquired assets from previous ones, it must also accept their liabilities. It is important to recognize that the climate change is primarily due to GHGs which were emitted when the developed world industrialized over the last two centuries. A 'burden-sharing' framework must recognize this fact.

The proposal also needs review because it rejects per capita entitlements for future emissions. Under GDR, the per capita entitlement—so-called developmental rights—of developed countries between 2011-2025 period is far higher than that of the developing countries. For instance, the per capita CO_2 emissions allowed to the US between 2011-2025 is about 12 tonnes per annum; for the UK it is about 9 tonnes per annum, while India is allowed a mere 1.65 tonnes per annum.

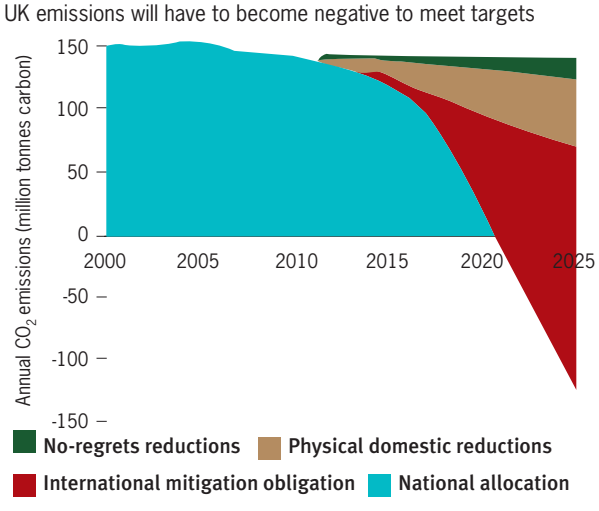
A recent Heinrich Boll Foundation sponsored study by Ecofys Germany exposed a few shortcomings of GDR and other burden-sharing approaches. It found that developing countries like India and Pakistan, which have low responsibility capacity index will not require to cut down much on emissions in the short term. However, these countries will be committed to far stringent commitments in the long term.

Despite these drawbacks, GDR shows that massive emission reductions are required from the developed world. It also shows how developed countries have over-consumed the global common environmental sink. Under the framework, wealthier countries have to reduce emissions by more than 90 per cent over 1990 levels by 2050.

Indeed, for wealthy countries like the US, the UK and Germany, reduction obligations exceed even total baseline emissions (see graph: *Hypothetical emissions reduction target under GDR*). So even if these countries were to reduce their emissions to zero, they would still be bound to pay for emissions reductions elsewhere. ■

Hypothetical emissions reduction target under GDR

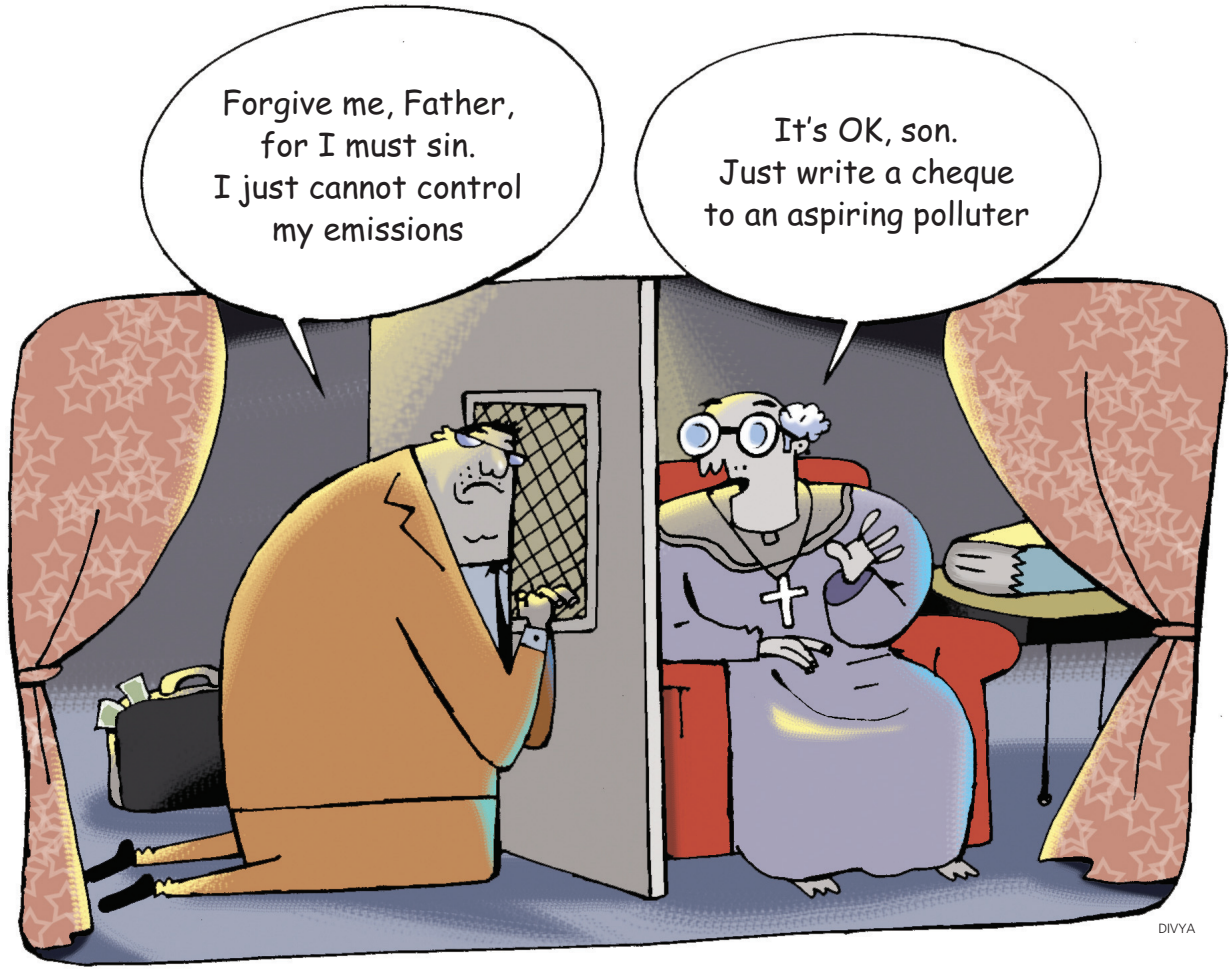
UK emissions will have to become negative to meet targets



Source: Greenhouse Development Rights, 2007

CARBON DISCREDIT

The Clean Development Mechanism must be amended. What shape should it take?

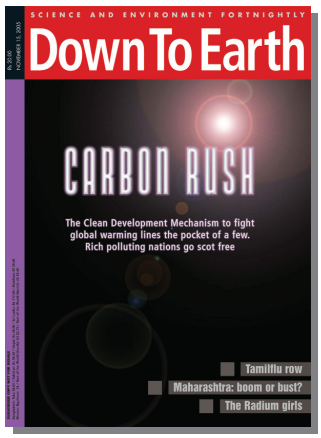


The Clean Development Mechanism (CDM) is up for review and there are several proposals to reform the process. The mechanism has always been under severe criticism, since its inception, on various accounts, ranging from its philosophical principles to its administration.

The mechanism was created to help the developing nations to access finance required to implement projects that would reduce emissions below a certain defined level. On the other hand, the same process is also expected to help developed nations to reach their emission reduction targets by paying for emissions avoided in the developing nations. But, over a period, the practice has turned out to be a process that has hardly helped avoid emission in the developing countries; moreover, it has provided emissions credits to the rich countries at a cheap rate.

Double agents

From its inception, the operations to promote 'clean' development through CDM has remained questionable. The most controversial operative in the game remains the Designated Operational Entity (DOE), or consultants accredited to the CDM Executive Board. These consultants are paid by project proponents even as they work for the board to validate a proposed project. This conflict of interest makes



Dirty mechanism

Clean development mechanism was meant to tackle climate change. A study by Centre for Science and Environment, New Delhi, found not only was this mechanism unclean, it was also corrupt.

Most of the money was going into dirty projects and the North was paying a pittance for them. The cheapest projects turned out to be the dirtiest with very little actual reduction. International auditing firms were found indulging in fraud by simply copying and pasting project design documents, vital for getting projects cleared. Local communities had no say and gained nothing out of these "private" deals.

CDM an opaque process. It is no wonder these consultants figure pretty high in the reform agenda. It is obvious in the climate negotiation parties acknowledge this faulty system and so are looking for changes.

Suggestions range from ensuring quality work 'through, for example, the accreditation process and frequent, in-depth spot checks of their work', to eliminating them by employing trained staff within the secretariat to validate the projects.

Stories abound on how these consultants lie in proposals to make projects look fit for certified emission reductions (CERs). The deception has resulted in approval of projects that hardly avoid unclean processes, are unsustainable in nature and get falsely tagged with additionality. Consideration of paying these consultants directly by the CDM board has also been suggested in the reform agenda.

There is also a hint of changing the composition of the Executive Board by creating better representation of various parties involved in negotiations.

A broader list

The mechanism is predicated on a list of activities for which credits are accepted. There is a growing demand to enlarge the list to include methodologies that can help avoid emission. Some of them are new technologies like Carbon Capture and Storage, that came much after the list was drawn up in 2001. But there are others, like the demand to include nuclear power in the CDM stable, that are seen to be just an easier way to earn credit for the developed world, which has failed to reach anywhere near its reduction targets.

One of the important proposals on the table, in terms of broadening the list of activities acceptable under CDM, is to introduce a sectoral approach in emissions reduction. The current mechanism allows only a programme of

activities to be registered for generating CERs. More activities may be added to the programme if they meet the original methodology and criteria for approving the project. The new proposal will allow processing of CDM activities to be sector wide. If allowed, under the new CDM regime, the Indian cement industry as a sector can consider a project, including development, registration and ongoing verification, as an aggregate sectoral entity. There are variations in approaches by different parties on this proposal. But, whatever the approaches, sectoral CDM activities will generate a high volume of CERs and will lower the cost of administration and technical assessment. On the other hand, there is also a fear that these projects will probably lower the price of CERs, by increasing its supply, without steps being taken for deeper cuts in the industrialised world.

Similarly, an inclusion of new nuclear power stations as CDM activity will pump up the supply of CERs significantly. Like the sectoral approach, this too will decrease the price of CERs. Both these approaches will reduce the burden of domestic mitigation on the part of rich countries as they will have access to large volume of CERs at a lower rate. In practical terms, this boils down to global mitigation being shouldered by developing countries at a cheap rate. In the case of nuclear power being a CDM activity, the incentive to develop renewable options will minimise, say critics.

International politics

A sudden surge by developed countries to break down the developing nations as one entity has also left some marks in certain CDM proposals. Currently, according to the spirit of the UNFCCC, any non Annex I country could host a clean project and sell CERs to an Annex I country. A new idea has been mooted to approve projects based on a country's development index. It must be noted that, in recent months, developed nations have been arguing that there are various stages of development among the developing nations and, thus, they should not be treated as one. There are speculations to use either a country's GDP or GHG emission per capita to decide the nature of projects a country can derive CERs from. It will be difficult to get this idea ratified as developing countries, specially stronger economies within the bloc, are expected to oppose it tooth and nail. There are also other worries of incorporating the dynamic nature of the prescribed indices into the mechanism. It will be difficult to decide continuation of a project if a host country's GDP or GHG emissions per capita goes up during the project period.

Marketing carbon

CDM has always been criticised as it does not push the rich countries to take a deep cut in their emission, badly needed to stay within a 2°C rise in global temperature. On the other hand, it is not surprising developing countries like India and China have maintained a near-monopoly in the CDM market with projects that do not reduce emissions substantially. A market-driven corrupt practice has also taken toll on the nature of the projects that get validated. Most of the projects selling CERs are not necessarily environmentally sound practices.

The largest CDM reduction has taken place for HFCs, and that can be linked to the market. The biggest business possible in the CDM market remains avoiding HFC-23, a gas almost 12,000 times more potent than CO_2 to cause global warming, as this can earn higher number of CERs. It is argued the refrigerant industry can earn almost double from CERs through destroying HFC-23 than what they earn from selling refrigerant. A CDM possibility actually signals the producers to produce more refrigerant.

The lower its price, the lesser the incentive to shift to renewables

The condition of additionality is the biggest hit in such a market operation. Michael Wara and David Victor of Stanford University, in their publication "A Realistic Policy on International Carbon Offsets", clearly show all Chinese new hydroelectric, wind and natural gas-fired plants have applied for CDM, arguing they could not achieve these projects without additional funds. Wara and Victor find it impossible to believe China was not in a position to generate any hydro, wind and natural gas-fired power at all without credit money coming in.

No real change

Easy and corrupt practices within CDM lead developing countries to have relaxed efficiency norms of energy use, as it helps them to show avoidance in a CDM project. It would have been more effective if the mechanism had helped developing countries go for ambitious norms and then get help from credit money to implement those projects, such as public transport and rural electrification through renewables, that will allow these countries achieve higher efficiency and sustainability.

The biggest barrier to reinventing the world's energy system is the price of the low-carbon technologies. The Intergovernmental Panel on Climate Change's fourth assessment report has concluded that a carbon tax (or price) of US $50-100 on a tonne of CO_2 equivalent is needed to make deep cuts in emissions in the world.

It is for this reason that a new-look CDM must include a minimum floor price, which will ensure only high end or transition technologies will get into the system. To begin with, the entry level price could be pegged at US $30-50 to provide the incentives for structural change. Currently, only EU and Japan are large buyers of CERs. A few more countries will be joining in future. But the biggest demand for credit will come from the US if they join the market. This high demand may increase the price of carbon in the future.

But till then, carbon price, like most other goods and services in a market condition, simply externalises the real cost of climate change. Most tellingly, a lower price of carbon will never make the options of renewables attractive. ■

HERE COMES THE SUN

India has had mixed results with its solar programme. The government is now gearing up to launch several mega schemes to harness this abundant source. The solar mission aims to do exactly that. Industry has also shown interest in tapping this energy source of the future. Technology and financing, though, remain question marks.

How can India realize its solar dream?

Picture thousands of solar reflectors, spread over parts of the Great Indian Thar Desert, glistening under the sun, quietly and efficiently generating emission-free, green electricity, at competitive costs. Solar thermal power plants, also called concentrating solar power (CSP) generating systems, can make this a reality. The potential is unlimited. Covering just one per cent of the world's deserts with CSP systems would generate more energy than the current global energy demands. For India the potential stands at six million terawatt hours (tWh) per year. In 2006-07 India generated 662.5 tWh.

A square piece of land, 55 kilometres each side, in the empty desert, is enough to meet India's current energy demand.

With more than 300 sunny days each year, large parts of Rajasthan and Gujarat can produce 6-6.4 kilowatts per square metre. Sparsely populated, these areas are ideal for renewable energy. This potential is yet to be realized.

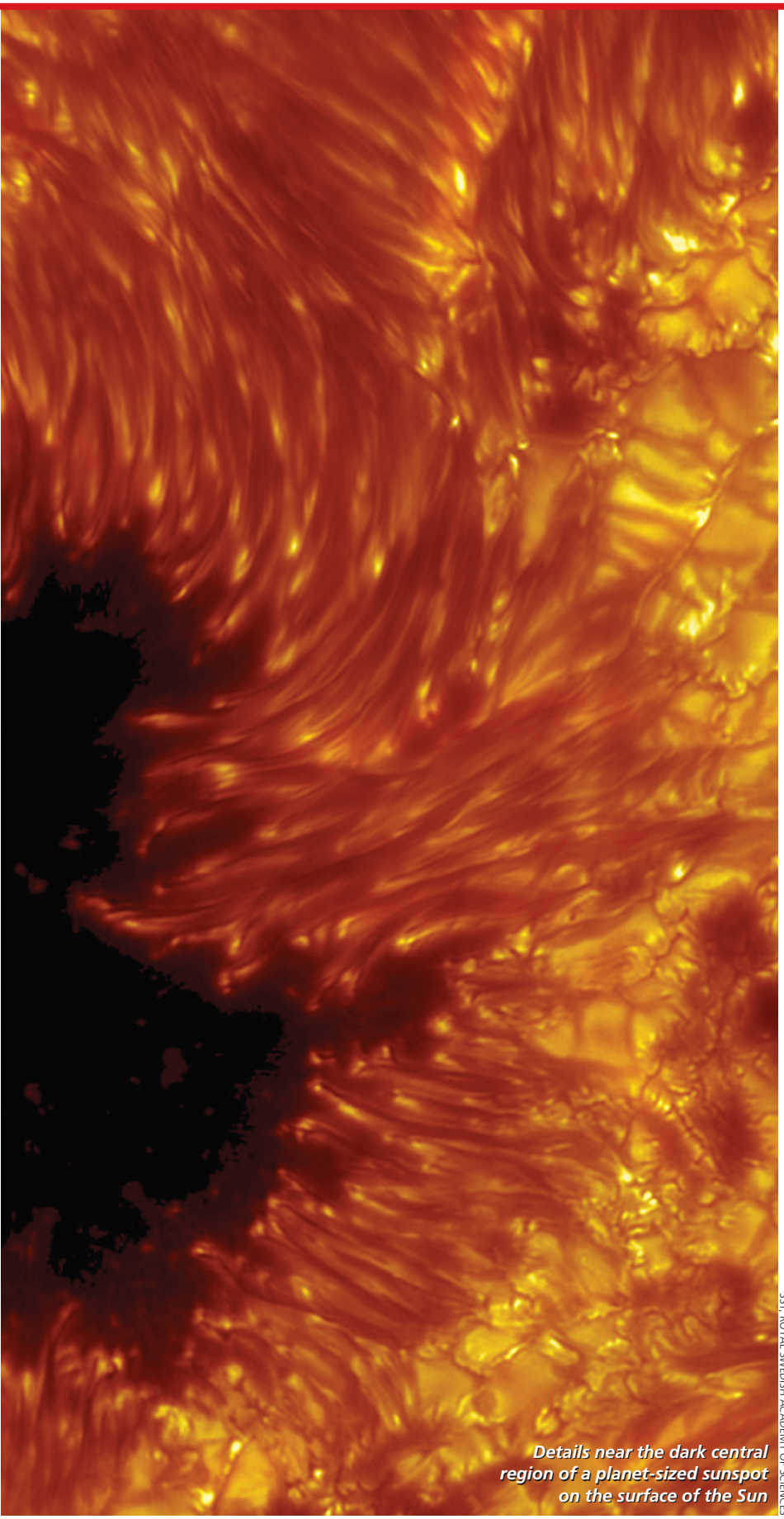
No commercial CSP system operates in the country. To induce projects, the Union Ministry of New and Renewable Energy (MNRE) announced in January 2008 a generation-based incentive scheme for solar thermal and solar photovoltaic (PV) ventures. The incentive for generating one unit of electricity from solar thermal is fixed at Rs 10. By June 2008, the government had received applications to set up 500 megawatts (MW) of solar thermal plants. "Companies are coming up with offers of huge capacity of 50 MW and more, but we cannot sanction them without verifying if they would be able to deliver," said an MNRE official.

The scheme has a number of limitations. The total installed capacity under the scheme (combined for solar thermal and solar PV) is limited to 50 MW for the duration of the 11th five-year plan (2007-2012). Each project developer is limited to a maximum of 5 MW and each state is limited to a maximum of 10 MW. "The cap of 50 MW is because of unstable grids and solar systems deficient in producing peaking power, which is generally needed during the evening hours," said B Bhargava, senior director (photovoltaics) MNRE.

This may change. Industry sources revealed the government was considering increasing the overall cap to 1,000 MW. Till now, only one 2-MW plant has been sanctioned under the scheme in West Bengal; construction is yet to start.

Mirror mirror on the wall...

In a solar thermal power plant, mirrors are made to concentrate sunlight trapped in a pipeline to heat oil, molten salts or other chemicals which can trap heat for a longer duration of time. This heat is used to generate steam in a boiler that runs a turbine to produce electricity. CSP technologies vary in how they concentrate sunlight. For example, in parabolic trough systems, parabolic trough-shaped mirror reflectors concentrate sunlight on thermally efficient receiver tubes placed in the trough's



Details near the dark central region of a planet-sized sunspot on the surface of the Sun

SST, ROYAL SWEDISH ACADEMY OF SCIENCES

focal line. A heat transfer fluid is circulated through the receiver tubes and heated to temperatures up to 400°C. The fluid passes its heat to other working fluid, typically water or steam, through a series of heat exchangers, which is further used to drive a conventional turbine generator. Other systems include the power tower system and the parabolic dish system.

CSP has higher operating efficiency and lower cost compared to PV. While even the most efficient solar PV can generate about 20 MW per sq km (km^2), for solar thermal generation it is about 35 MW/km^2. CSP also has major advantages in energy storage, a critical component of technologies harnessing intermittent energy sources like wind and solar. The storage allows for higher plant capacity factors, compensation for vagaries in solar radiation, increased ability of the plant to provide firm capacity and consequently greater carbon dioxide (CO_2) emissions reductions.

These assume greater importance in India, given its weak inadequate grid and generation capacity, translating to limited grid back-up capability. CSP systems can be easily integrated into conventional power plants as they utilize the same generator as most other fossil fuel based thermal power plants.

The exact cost of CSP systems is currently a grey area, primarily because of a lack of standardization as the technology is still developing. Apart from technology, the plants vary greatly in specifications like storage capacity, efficiency of solar field, and generation capacity of the plant. However, qualified cost forecasts put down the capital costs of a parabolic trough plant—with 12 hours of storage capacity, no fossil fuel back-up and a nearly 55 per cent capacity factor—at US $4,816 per kW (total plant capacity of 100 MW) in 2004, and US $3,220 per kW (total plant capacity 400 MW) in 2020. The respective costs of electricity are US 10.37 cents and US 6.21 cents per unit. These costs are far lower than even the most efficient solar PV systems on per watt basis. CSP plants present the possibility of a high local content during construction and operation and maintenance, unlike solar PV where silicon—the major cost component—has to be imported. Additionally, carbon credits can serve as an income stream to reduce the cost.

Initially, projects in solar thermal failed to take off. New incentives have resulted in renewed interest

Over the past two years, rising oil prices have brought CSP systems into sharp relief. Countries such as the US and Spain have taken the lead; Australia, Israel, Morocco and even the oil-rich countries of Iran and Algeria have shown progress. In Spain, construction of the world's biggest solar thermal power stations—Andasol 1 and 2—are almost complete.

By early 2008, as much as 4,000 MW of solar thermal was in the pipeline in Spain and five more plants are underway. The German company Solar Millennium AG and the Spanish plant builder Cobra is building Andasol. They are working on liquid salt, which can be heated to 500°C—oil can be heated to only 400°C. The plants would use liquid salt to store heat during the day to generate electricity at night.

India stumbles

Though India was one of the first industrializing countries to show interest in CSP technology, it failed to keep up the momentum. As early as 1988, a 50-kW parabolic trough technology pilot project provided by the German company MAN Technolgie GmbH and Co, was established at the government-run Solar Energy Centre campus in Gwalpahri near Delhi. Within two years the glass casing that maintains the vacuum around the pipelines that trap the heat started cracking due to excess heat rendering the plant inefficient. "Being imported, damaged parts could not be replaced," said Prakash, caretaker of the facility.

In 1994 a feasibility report was prepared for a fossil fuel-solar hybrid project in Mathania, near Jodhpur in Rajasthan. India was the first of the four countries to be given the Global Environment Facility (GEF) grant for this project of US $49 million.

Despite arranging for complete finance for the project, it was abandoned due to rising prices of naphtha (the primary fuel), limited guarantees by private contractors for working and spare parts, and lack of commitment to lay down a gas pipeline to substitute naphtha with natural gas as primary fuel.

In 1995, a Solar Energy Enterprise Zone (SEEZ) was also envisioned in Rajasthan and three power purchase agreements were signed with AESDP, Sun Source Ltd and Energen International Ltd for a total solar generation capacity of 300 MW. None of projects of the SEEZ ever took off, owing to lack of finances.

The MNRE scheme has led to renewed interest in CSP. The Rajasthan Electricity Regulatory Commission had invited expressions of interest (EOI) for solar PV and thermal power plants in February 2008. EOI to setup 900 MW has been received so far.

"Companies such as India Bulls and Essar have responded with an EOI. Applicants were required to pay Rs 25,000 per MW for registration," said A K Patni, in charge of the solar cell at the Rajasthan Renewable Energy Corporation Ltd.

MNRE recently proposed another scheme for installing 20,000 MW of electricity from solar thermal and PV by 2020. But the incentive pattern it proposed is so high that the cost to the exchequer would be about Rs 20,000 crore per year in subsidy alone.

Many in the government believe it is not viable at this stage and that the ministry will find it impossible to fund such a scheme.

AGNIMIRH BASU / CSE

Shine a light

Solar lanterns were promoted specially for use in rural un-electrified villages. Costing Rs 2,000- 5,000 for a 7-11 watt power lamp, it requires little maintenance.

A solar lantern is made of three main components: the solar PV panel, the storage battery, and the lamp itself. The solar energy is converted to electrical energy by the solar PV panel and stored in a sealed battery for later use after sundown.

A single charge can operate the lamp for about four-five hours. But it varies upon the kind of material used—it can go up to five-six hours. The wide difference in the cost of these lamps is due to the material used.

A battery costs Rs 400-500 while a lamp costs Rs 700-800; the rest is the cost of the PV panel. "The cost of the lamp can go up with the use of light-emitting diode (LED) bulb instead of compact fluorescent lamp (CFL) but the cost of the PV panel will accordingly come down because LED requires smaller panels.

The difference in the material used (crystalline or amorphous) in the panels also contributes to the cost difference," said G Giridhar of Solar Energy Centre.

The Union Ministry of New and Renewable Energy has reportedly proposed a scheme to distribute lanterns with a subsidy of Rs 3,000 on each. But energy experts differ. They say it would be better to provide low-interest loans to lantern manufacturers instead.

They estimate the costs of the lantern can be recovered without using a subsidy mechanism. In the past subsidies for such technology dissemination have often failed.

CURRENT TRENDS

ARVIND YADAV / CSE

Solar photovoltaics is the fastest growing area in the energy sector. Of the US $71 billion invested in renewables worldwide in 2007, 30 per cent was in solar PV. According to market analysts, between 2007 and 2011, this industry is poised to grow at a whopping 73 per cent. By March 2007, India had 120 MW of installed PV capacity. However, less than 2.5 MW is generated by grid-connected solar power plants. The rest is generated through stand-alone systems like solar street lighting (about 70,474), home lighting (4,02,938) and solar lanterns (6,70,059).

The government has several schemes supporting and subsidizing various kinds of solar power systems. The emphasis is on encouraging manufacturing and industry rather than on installations as solar PV manufacturing is capital intensive. Through the special incentive package scheme, the government offers capital subsidies to state-of-the-art semiconductor manufacturing and related units, including solar PV. Eligible semiconductor "fab" projects must have a net present value of at least Rs 2,500 crore. The subsidy available is 25 per cent of the capital expenditure; it is 20 per cent for projects in a special economic zone. The response was good. "Most of the manufacturers who have applied under the scheme want to invest in photovoltaic technology. Proposals roughly worth Rs 1,40,000 crore from 14 manufacturers are lying with the ministry of which 12 are photovoltaic manufacturers" said K S Chari, director in the Union Ministry of Communications and Information Technology, the nodal ministry. Most of the proposals have been forwarded to a technical evaluation committee and decision is expected "shortly".

The recently announced feed-in-tariff incentive scheme of MNRE has also sparked considerable interest. The scheme is aimed at encouraging a small number of megawatt-level projects. Under the scheme, the project developer makes a power purchase agreement (PPA) with the state utility at the highest existing market rate. The MNRE, through the Indian Renewable Energy Development Agency (IREDA), augments this rate, to a maximum of Rs 15 per kWh. The maximum supplement incentive from MNRE is restricted to Rs 12 per kWh. This will be reduced by 5 per cent for projects commissioned from the beginning of 2010 onwards. The supplement is available for up to 10 years. Till June the ministry received applications to set up PV plants totalling 2000 MW. The proposals are currently being scrutinized.

Globally, solar PV projects are being installed in large numbers each year. In 2007, more than 2,260 MW of PV capacity was installed, an increase of more than 50 per cent over the previous year. This brought the total installed capacity to 7,800 MW. About three-fourths of the total solar PV capacity was installed in Germany and Spain alone. If Japan and the US are also included, then over 90 per cent of PV installations in 2007 occurred in four countries.

Germany: Powering ahead

Germany currently accounts for about half of the world's installed solar power capacity—3,862 MW. This growth happened due to its market support measures promoting grid-connected rooftop systems and large PV power plants. Germany's innovative feed-in tariff (FIT) scheme has been the main driver for the solar market. The German FIT scheme, governed by the country's

Table 1

Solar PV installation in 2007

Country	Solar PV installation in 2007 (in MW)
Germany	1,135
Spain	512
Japan	210.4
US	206.5
Others	236
Total	2,260

Source: Trends in photovoltaic applications: Survey report of selected IEA countries between 1992 and 2007, International Energy Agency

Table 2

2008 Feed-In Tariff rates in Germany (€/kWh)

Building-mounted systems			Free-standing systems
<30 kW	30–100 kW	>100 kW	All sizes
0.4675	0.4447	0.4398	0.3549

Note: Rates are given for 20 years

Renewable Energy Sources Act (EEG) guarantees generous fixed rates for all solar PV electricity generated for 20 years from completion of the project. An important feature is that the rate guaranteed for new projects decreases every year—currently by 5 per cent but this is set to increase in 2009.

The decrease in tariff is part of the policy package as it works to push manufacturers to reduce costs and to increase efficiency of their systems. This tariff reduction encourages industry to develop cheaper, more efficient systems and to lower installation costs. The precise rates given depend on the system size and location.

In 2008 they stand as shown in Table 2 (see facing page).

The FIT scheme is backed by favourable loans from KfW, a government-owned financial institution. Loans are provided in collaboration with individual banks; interest rates are dependent on credit ratings and the value of collateral, starting at 4.63 per cent. The programme as a whole has created a very large consumer base for solar PV in Germany. This, along with special financial incentives packages for manufacturing in certain regions and funding for research, has helped to create a flourishing PV production industry in Germany.

Critics of the German scheme say it is too generous—the cost to energy consumers is too high and the use of such an expensive technology in a country with relatively low sunlight hours is inefficient. However, on the whole, it is estimated that the FIT programme is responsible for an increase of €1.01 in monthly household electricity bills.

Photovoltaics need aggressive support. Feed-in-tariffs guarantee investors long-term security

Leading the charge: California

California was the first state to introduce feed-in remuneration. Its tightly restricted feed-in programme will supply the development of up to 480 MW of total generating capacity (roughly equivalent to a small coal based power station). In all cases, feed-in contracts for 10-20 years can be entered only for installations up to 1.5 MW capacity and the range from US 8-31 cents per kWh, depending on the time the power is delivered—peak consumption time, winter or summer. As a result of this policy directive, the two big power utilities of the state—Southern California Edison and Pacific Gas and Electric Company have signed power purchase agreements—for 245 MW with eSolar and 500 MW with Bright Source,

Water heaters

Despite several schemes, both centrally and state sponsored, to promote solar water heaters sales have been low. A major reason has been a lack of trust on the quality of device supplied by the government appointed manufacturers. Under a central subsidy scheme of the MNRE a soft loan is made available at the rate of two per cent for domestic users, three per cent for institutional users and five per cent for commercial users who also avail of accelerated depreciation under the income tax rules. However, in few states including Himachal Pradesh, north-eastern states and Jammu and Kashmir an interest-free loan is given to domestic users. The scheme is implemented by Indian Renewable Energy Development Agency Limited (IREDA) through a select few nationalized banks. A person availing of this scheme needs to collect an invoice for the kind of solar water heater he is buying from one of the MNRE authorized dealers. He then has to approach a bank, which in turn issues a cheque in the dealer's name after verifying facts. The borrowers will be eligible for loan up to 85 per cent of the cost of systems repayable over a period of 5 years. The difference between the lending rate of the banks or financial institutions and the rate of interest given to the customer (2-5 per cent) is borne by MNRE. Under the scheme about 2.5 million square metres of collector area has been installed in the country till date.

Several states offer their own schemes to promote roof-top solar heaters. Delhi offers a rebate of Rs 6,000 to every customer who buys a solar water heater for domestic use. "So, if the cost of a heater with a capacity of 100 litres per day is Rs 16,500 along with 4 per cent VAT, he just has to pay us Rs 11,160," said Anuj Mittal of Natural Energy Systems, an approved dealer. This rebate can extend up to a maximum of Rs 60,000 for heaters with a capacity of 1000 litres for non-commercial/institutional users. The rebate is given by dealers who then claim the difference (Rs 6-60,000) from Delhi Transco Limited, which handles the scheme for the state government. "The scheme was launched in December 2006. Till date, 318 domestic users and 28 institutional users have availed of it," said Rishi Raj, public relations officer of Delhi Transco. To boost the usage, in September 2006, the Delhi government came out with a notification to make solar water heaters mandatory in certain buildings including government departments, institutions and agencies and all hospitals. All Delhi government departments, municipal bodies, Tihar and other jails of Delhi police were supposed to amend their byelaws, within a period of six months, to make the use of heaters mandatory. They also had to designate a nodal officer to monitor the progress and send a report of the same to Transco on a quarterly basis, which was assigned the responsibility of implementation. Till date no monitoring report has been sent to Transco. Since there is no clause for penalty for not following the order in the notification all departments go scot-free in case of non-compliance.

According to the calculations done by the Centre for Science and Environment, Delhi can save Rs 272 crores and reduce CO_2 emission by 7.7 lakh tonnes in winter, if 50 per cent households in Delhi install solar water heating system of capacity 100 litres per day/ 60°C. And if they operate for 320 days in a year, the annual saving would be around Rs 821 crores and the CO_2 reduction would be around 23 lakh tonnes.

Challenges of PV

The main component that converts photons into electricity in a solar PV is the layer of silicon semiconductors. In 2007, the solar PV industry along with the semiconductor industry consumed some 38,000 tonnes of poly-silicon. This grew to 58,000 tonnes in 2007. Increasing demand has led to price jump of more than 100 per cent from US $20 per kg in 2001 to US $50 in 2006.

The future of PV industry depends on two factors: bringing down the cost of the panels and increasing their efficiency. Currently, the panels use about 10 gms of poly-crystalline silicon to produce 1 W/p (watt/peak) of energy, which is down from 13 gms a few years ago. The efficiency of solar panels has grown from 10 per cent in the 1990s to more than 13 per cent at present. The monocrystalline cells have recorded efficiencies of almost 25 per cent under lab conditions, while polycrystalline cells have surpassed 18 per cent. Researchers are now trying to target PV cells that can function at 30 to 60 per cent efficiency. One such technology is the concentrated photovoltaic cells. There are also other technologies which are beyond conventional junction semiconductors and use photoelectrochemicals, polymers and dyes.

respectively. In 2007 around 70 per cent of all PV installations in the US were in California, which aims to install 3,000 MW in the next 10 years.

The California Solar Initiative provides two kinds of financial incentive depending on the system size. Systems under 50 kW are eligible for the expected performance based buy-down, a one time, up-front payment. The size of the payment is calculated from the estimated output of the system, based on rated capacity, but also an assessment of the quality of the installation, including geographical factors such as location, tilt and shading. Systems over 50 kW can receive the feed-in-tariff. For both payment methods, the rates applicable are linked to the cumulative capacity installed under the scheme, reducing in 10 steps as capacity increases.

India's solar future

Harnessing power from the sun is one of the biggest answers to challenges of energy security and climate change. Both solar thermal and photovoltaic will play a key role in addressing energy needs of the future. It is clear that the biggest challenge is to bring down the costs of solar PV—by cutting costs or by increasing efficiency.

The government has shown commitment but implementation and the nature of schemes have been found wanting. Take for instance, the heaters promotion scheme. "The problem with such schemes is that it comes through dealers designated by the government so it is difficult to trust the quality mostly," said Mathew Kochu SJ, director of Xavier's Institute of Technology in Mehsana district of Gujarat, who have installed solar heaters and lights in their entire institute. A national level certification and labelling programme is a must to ensure quality and performance.

Once this is done laws and regulations like changes in building bylaws making it compulsory to install both solar thermal and PV features are the kind of reforms the sector needs. "Like Europe and the US, we should make at least two to three per cent contribution from solar generation mandatory. Then, policy-making on the same will become faster," said an IREDA official.

Finances and the limited technical know-how remain the key barriers for the solar projects in India. Innovations are needed to make solar projects financially and technologically feasible. A hybrid system or a system with high fossil fuel back-up, along with increased government technical and financial support and incentives, facilitation of technology transfer, will increase the market interest in CSP technology.

The Indian government has announced a generation-based incentive scheme. It is even considering ramping up solar generation to 20,000 MW. But finances will remain a big issue. The feed-in (or preferential) tariff provides an incentive to set up the plant, but it also puts a huge burden on the exchequer. This is why governments only extend the high tariff incentives in a restricted capacity. India's solar programme must therefore be able to source new funds—through a programmatic CDM—instead of each project applying separately for CDM. The government can collect all the carbon credits from solar projects and sell it collectively in addition to securing international finances to pay for national mitigation actions.

The money generated from selling carbon credits can then be used to fund feed-in-tariff schemes and reduce the subsidy. Reducing or even eliminating import duties, will reduce indirect costs and ease technology transfer from countries such as Germany, the US and Israel—the world leaders in technology. Its strong engineering and manufacturing foundation will surely allow India to become a leader in solar technologies in the future. After all, a massively scaled up solar programme is good for India. It is good for the world. ■

With inputs from Ravleen Kaur and Arnab Pratim Dutta

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India must source funds for solar projects through programmatic CDMs, not project-based CDMs