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Energy Security Insights

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India–China energy perspectives

India and China's energy demand growth is unfolding in the midst of a perfect storm: economic, geopolitical, and environmental factors are combining to create new challenges, pressures, opportunities, and alliances. High projected economic growth rates call for greater availability of energy; low per capita energy consumption and access to energy make reduction of energy poverty a key development goal. As these countries find that domestic sources are insufficient to meet their energy demands, they turn to external sources, especially to countries in West Asia and Africa. In their search for overseas oil and gas, they have been characterized as exhibiting a 'hunger for resources'. They have also, on occasion, been pitted against each other, and this competition has given rise to concerns about the potential for a reemergence of conflict over resources. A new consciousness is emerging of the old and new energy ties being forged by India and China in West Asia, in Africa, in Central Asia, a consciousness by the West of the new geopolitics that this engenders and a realization by West Asia and Africa of the attractiveness of Asia as an alternative to Europe and the US. On another front, climate change and the links it has with energy and energy choices are also creating considerable pressure for low-carbon economy paths for these emerging economies, adding yet another restraint to energy choices and a new geopolitical dimension.

This issue of *Energy Security Insights* focuses on the development challenges the two countries face, the energy choices they are making, and the way they are shaping, in things they do and not do, the emerging energy order. This issue examines the case, the context, and scope for energy cooperation between the two countries and narrows down on some possibilities for further analysis and action.

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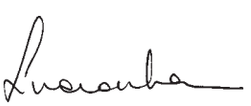

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India and China in the emerging energy order

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The significance of India and China in the emerging world energy scene is becoming a subject of widespread interest and attention. It is no coincidence that in the G8 Summit held in Gleneagles in 2005, the leaders of five emerging economies were invited as outreach countries essentially because the leaders of the G8 felt the need for engaging countries like China and India in strategies related to the energy sector and in limiting the growth of emissions of CO_2 (carbon dioxide), as China and India are projected as major contributors of CO_2 in the future.

It, therefore, does not come as a surprise that the annual publication of the IEA (International Energy Agency), namely the *World Energy Outlook*, which is an authoritative reference work for those dealing with energy decisions worldwide, in its 2007 edition focuses on China and India. News reports in the media and by leading commentators in other fora are also increasingly referring to China and India as two major players who would determine the future of global energy markets. Three issues are key here: their increased energy demand, especially for oil; their dependence on oil from the Middle East; and their growing share of carbon emissions. Box 1 summarizes their projected energy needs over current consumption.

In purely quantitative terms, if one refers to the projections of the IEA, then China and India would certainly become far bigger consumers of oil than current levels would indicate. For instance, in 1980, out of a total world consumption of 64.4 MBPD (million barrels per day), China and India accounted for a total of nearly 2.6 MBPD. But by 2030, out of a total demand of 116.3 MBPD, these two countries would account for 20.7 MBPD. China imports 51% of its oil; India over 72%; and the future trends for both the countries are in the range of 70%-90%. Energy security analysts also view the share of China and India in terms of the demand that they would place on the countries in the Middle East, which are the members of the OPEC (Organization of the Petroleum Exporting Countries). Current dependence on oil imports from the Middle East is high and growing. While India currently imports 68% of its oil from this region, China imports 40%. Oil consumption by China and India is seen as a factor in determining the security of oil supply particularly from the OPEC countries in the Middle East.

Box 1 Growing energy needs (2002–30) (figures in brackets are consumption in MTOE in 2002)

India	China
■ Coal: 2-fold (300)	■ Coal: 2-fold (641)
■ Gas: 4-fold (29)	■ Gas: 2.4-fold (122)
■ Oil: 2.3-fold (148)	■ Oil: 2.6-fold (389)
■ Hydro: 3.6-fold (13)	■ Hydro: 2.5-fold (38)
■ Nuclear: 5.8-fold (24)	■ Nuclear: 10.5-fold (66)
Source TERI estimates	**Source** WEO (2005)

In conjunction with energy security implications, there is now much more vociferous articulation of concerns regarding the share of emissions of greenhouse gases emanating from China and India.

In the past, there has been some degree of coordination between the two countries in formulating their positions vis-à-vis the developed world in the field of climate change negotiations. However, the extent of coordination is limited, leaving a gap between the positions that the two governments take from time to time in advancing their interests against growing pressure from the developed countries for bringing both the countries into a regime of some restriction in emissions of greenhouse gases. At the same time, in the quest for finding new hydrocarbon and other resources in various parts of the world, China and India have in recent years been competing for the same opportunities, but in this regard China has clearly taken the lead. This, of course, is driven by

the fact that China's growth in demand for oil and natural gas is significantly higher than that of India. Chinese policy-makers and thinkers also view the current situation within the larger framework of shifting balance of power on the global stage. China, which is emerging as a global superpower, sees the exercise of its 'soft power' as helping it to gain access over resources in different parts of the world and its economic muscle helping it to dominate regions of interest from this viewpoint. A recent paper by Zhao Gancheng entitled 'The Rise of Chindia and its Impact on World System' views the emergence of the two countries in a political context and assesses the impact of this trend on the world system and on the geopolitics of trade relations as well. Undoubtedly access to energy resources, particularly those involving exploration and production rights in other parts of the world, would be the function of political power and geopolitical factors. Even in terms of access to new technology, any favoured treatment would be dependent on changing political equations. For instance, the civilian nuclear cooperation between the US and India is the result of changing perceptions on the part of the US of India's future strength as a power on the global scene. Secretary of State Condoleezza Rice has explained the US shift in policy on the basis of two major reasons. First, India's nuclear weapon programme is seen as legal because the country has not signed the NPT (Nuclear Proliferation Treaty) and second, India has an impeccable record of non-proliferation.

Two important factors would determine the positions of China and India with respect to future energy initiatives. First, for reasons that are domestic rather than international, both countries will have to move away from the conventional energy path. With oil prices hovering around $80 per barrel, oil imports would become a major economic burden and a threat to security of supply against rapidly increasing demand and the prospect of further price increases. Another reason relates to local environmental concerns, arising out of the escalating use of private automobiles in both societies. Even if China and India made large-scale and unprecedented efforts to improve energy efficiency across the board in every sector of their economies, the challenge of ensuring adequate supply of conventional forms of energy will keep mounting in the coming decades.

While both the countries will make some efforts that are largely similar in meeting this identical objective, there would have to be many distinct differences in their respective strategies as well. For instance, enhancing coal supply in China is not likely to encounter significant problems in the foreseeable future. India, on the other hand, can only increase coal supply in the future most likely with growing dependence on imports. This would be largely the consequence of constraints that are likely to be encountered in mining larger quantities of indigenous coal and removing bottlenecks in transportation, which would be in the form of inadequate capacity in the country's railway system. In the case of coal imports too, ports and matching inland transport infrastructure could prove to be inadequate. Hence, India would need to take conscious decisions to put in place these facilities on a predetermined scale, if it has to augment coal consumption in the future. If this were to occur, India could become a major buyer of coal in the international market. China, on the other hand, has not only adequate resources of coal that can be mined with existing technology and at appropriate depths, but the country has also shown an ability to create adequate infrastructure on a timely basis for transporting coal that is mined to locations where demand would occur in the future. In India, a large proportion of coal deposits exist at depths where mining with current technology is neither feasible nor economically viable. This, of course, could change with the development of technology for in situ gasification. But the country has lost almost two decades in mounting any serious programme of R&D (research and development) in this area because of disputes between the ministries dealing with coal on the one hand and oil and natural gas on the other. Now that the ONGC (Oil and Natural Gas Corporation) has been given a mandate to pursue the development of suitable technologies for underground gasification of coal, progress may be achieved towards viable and environmentally preferable technologies for exploitation of India's vast coal resources below a depth of 600 metres.

As far as augmentation of oil and gas supplies is concerned, India is placed

geographically in an advantageous position as it can tap large supplies of natural gas from its neighbourhood. But in this area as well, lack of agreement in inter-ministerial initiatives has resulted in loss of opportunities or delays, and escalation of problems in turning these possibilities into realities. An example of this lies in the tardy progress in the project for supply of natural gas from Iran by pipeline through Pakistan. This project was first conceptualized in 1989 by this author and Dr Ali Shams Ardekani, who later became Deputy Foreign Minister of Iran. But, the inability of the Government of India to bring this admittedly complicated project to closure has now led to the escalation of costs and the price of gas on offer from Iran as well as growing disapproval from the US, which could further delay its implementation. A similar lack of urgency and inter-ministerial coordination on the part of India has resulted in the recent loss of possible supply of gas from Myanmar, with China having bagged this contract through adroit handling of the political and economic dimensions of this opportunity, even though India had the initial advantage in this deal.

While large-scale trade in natural gas using pipeline transportation is critically dependent on the distance between the supplier and the buyer, such a limitation does not apply to supply of oil, wherein transport costs do not seriously impede the economic attraction of secure supply even from long distances. It is for this reason that both China and India are scouting for opportunities to invest in oil supply options across the globe. Even though China has been much nimbler and distinctly more effective in tapping available options, it is not necessary that this advantage will be maintained in the future as well.

In a recent essay in the *TIME* magazine, Bill Powell elaborates on 'The Limits of Power' in the context of China. He admits that China's influence, particularly in its East Asian backyard, is burgeoning and that its direct investment, loans, and aid to poorer countries are soaring, especially in resource-rich Africa. But in the author's view 'soft power's' real potency comes not from what other countries' governments think of you, but what their citizens think. The essay points out that China's economic might may be growing but one should not underestimate its global image problem. On the other hand, he gives India a better report card on the image front. In future deals for accessing global hydrocarbon resources, this factor would no doubt prove to be of some consequence, although China in several respects is far more forward looking in spotting opportunities as I found in a seminar that the then Prime Minister of Norway had invited me to in Ny Alesund in the Arctic region of Norway in 2006. A group of people from China was present on the occasion, and when I asked the hosts about Chinese interest in melting of Arctic ice on account of climate change, the answer given was that China is looking at the prospect of Arctic sea routes opening up to provide access to the region's hydrocarbon resources.

The US Geological Survey estimates that the Arctic seabed and subsoil hold as much as 25% of the world's undiscovered oil and gas. Nickel and diamonds are among other resources that exist in the region as well. Among the eight states that border the Arctic, all but the US have signed the UNCLOS (United Nations Convention on Law of the Sea), agreed after prolonged negotiations in 1982. The treaty stipulates that countries can extract natural resources within 200 miles of their coasts, but they can claim more if they can prove their continental shelves extend further into the sea. This provision has led to Russia planting its national flag below the North Pole recently in an effort to claim a larger territory than obvious, symbolized by this dramatic gesture. It claims that the Arctic seabed and Siberia are linked by one continental shelf, which gives it a claim to the entire area north of Siberia extending up to the North Pole. China does not have a seat at the table among these eight Arctic region countries, but by exercising its 'soft power', it hopes to strike deals with the countries directly involved for a share of the pie. Chinese need for oil cannot possibly overlook such a highly prized prospect.

In assessing the role of China and India in the new energy order, some reference to the recently concluded nuclear deal is essential. While no dramatic increase in its nuclear capacity is foreseen in the near future, India could now become much more secure in supply of fuel for conventional nuclear plants. Access to technology under the relaxed regime in the international arena could

prove to be an additional factor stimulating much more vigorous growth of nuclear power in the country.

With respect to renewable energy technologies, a more purposeful strategy to promote the development and spread of these technologies would have a major impact on global markets for related equipment. For instance, India has seen an increase in production of PV (photovoltaic) modules in recent years, but the bulk of this output is for export. If a policy of regulatory measures and fiscal incentives is adopted to promote expansion of use of PV devices in the country, then either manufacturing facilities would have to be expanded or exports would give way to domestic consumption. Similarly, if the market for energy-efficient technologies, ranging from lighting devices to new industrial process equipment, were to be stimulated through similar policy measures, the impact on the global market would be sizeable. If China and India were to launch a similar set of measures simultaneously, on the basis of domestic or global considerations, then the impact on global demand could be staggering. Already these emerging markets are beginning to become the core centres of investment in renewable energy. China is perceived to be the top investor in renewable energy world wide according to *REN21 2006* report. China's additional investment in large and small hydro and in solar water heating in 2005 was about $17 billion (*REN 21 2006*; p. 9). In 2005, China already had 23% share of the total 182-GW (gigawatt) world renewable power capacity (excluding large hydro) and India had 7.5% share of the total wind power capacity (Table 1).

Actually, both China and India are likely to adopt ambitious measures for energy use efficiency on an increasing scale in the coming years as well as diversify their energy supply bases towards greater use of natural gas as well as renewable energy technologies. These would not only place an increased demand for related supplies on global markets but would also have significant possibilities for the two countries themselves becoming major suppliers over time.

One such technology could involve tapping the potential of converting cellulosic material into ethanol. The IEA has estimated levels of production of ethanol and bio-diesel in major countries in 2005 (Table 2).

Current technologies for producing these fuels are based on conversion of food crops into

Table 2 Biofuel production by country (2005)

Country	*Ethanol*		*Bio-diesel*		*Total*	
	MTOE	Kb/d	MTOE	Kb/d	MTOE	Kb/d
United States	7.50	254	0.22	5	7.72	259
Canada	0.12	4	0.00	0	0.12	4
European Union	0.48	16	2.53	56	3.01	72
Brazil	8.17	277	0.05	1	8.22	278
China	0.51	17		Negligible	0.51	17
India	0.15	5		Negligible	0.15	5
World	**17.07**	**579**	**2.91**	**64**	**19.98**	**643**

Source IEA (2006)

Table 1 Renewable electric power capacity (in GW, existing as of 2005)

Technology	*World total*	*Developing countries*	*China*	*India*
Small hydropower	66	44	38.5	1.7
Wind power	59	6.3	1.3	4.4
Biomass power	44	24	2.0	0.9
Geothermal power	9.3	4.7	~0	0
Solar photovoltaic grid	3.1	~0	~0	~0
Solar thermal electric	0.4	0	0	0
Ocean (tidal) power	0.3	0	0	0
Total renewable power capacity (excluding large hydro)	182	79	42	7
Large hydropower	750	340	80	n/a

Source Extracted from Table 4. *REN21 2006,* Global Status Report, <http://www.ren21.net/pdf/RE_GSR_2006_Update.pdf>, last accessed on 9 August 2007

Table 3 People relying on biomass resources as their primary fuel for cooking, 2004

Country	*Total population*		*Rural*		*Urban*	
	%	Million	%	Million	%	Million
Sub-Saharan Africa	76	575	93	413	58	162
North Africa	3	4	6	4	0.2	0.2
India	69	740	87	663	25	77
China	37	480	55	428	10	52
Indonesia	72	156	95	110	45	46
Rest of Asia	65	489	93	455	35	92
Brazil	13	23	53	16	5	8
Rest of Latin America	23	60	62	59	9	25

Source IEA (2006)

fuel, largely driven by fiscal incentives or mandated levels of usage as in the case of ethanol as a substitute for petrol. But there is a large production potential in the developing world of agricultural residues, which as a result of well-directed research could be converted to liquid fuels such as ethanol. Table 3 shows the number of people dependent on biomass resources for cooking across the world. Biomass is consumed largely at very low levels of energy efficiency, with serious environmental and health effects, primarily on women and children sitting around a cooking device. The development of technological solutions for decentralized conversion of biomass into liquid fuel could benefit the poor not only through lower quantities of use of these fuels but also by enhancing the incomes of farmers, because some of their output would go to the market as well.

The sheer size of India and China in terms of their people, economic growth, energy demands, and potential markets for energy equipment is clearly changing the nature of the global energy business. The focus of attention of energy consumption has now shifted to these countries. They are also driving change in ways in which this consumption is being met, either through the energy initiatives that they are engaging with or through the search for new sources of oil, gas, and coal, which are creating new geo-strategic concerns. The way these initiatives play out over the next decade or so in the global and regional context will be central to the new energy order.

Reference

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Engaging the Asian giants in the energy and climate debate[1]

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The climate change debate is at a height at the moment, driven by several factors such as the approach of the first commitment period of the Kyoto Protocol and the call for discussion on future commitment periods; the increased body of scientific and policy research such as the Stern report and the *IPCC (Intergovernmental Panel on Climate Change) Fourth Assessment Report,* which calls for actions to combat climate change; and the occurrence of extreme events across different parts of the world causing an increased recognition that climate change is no longer just a threat in the distant future.

Article 3.1 of the Kyoto Protocol calls for reduction in GHG (greenhouse gas) emissions of Annexe I[2] countries by at least 5% below the 1990 levels by the first commitment period, that is, 2008–12. Regarding the actions beyond the year 2012, the Protocol Article 3.9 mentions that the commitments for subsequent periods for Annexe I Parties shall be established in amendments to Annexe B of the Protocol, which describes the quantified emission limitation, or reduction commitments for Annexe I countries. Article 3.9 further mentions that the COP (Conference of the Parties) serving as the Meeting of the Parties (MOP) to this Protocol shall initiate the consideration of such commitments at least seven years before the end of the first commitment period.

According to the above provision, the negotiations for the Annexe I country commitments post-2012 should have been initiated by the year 2005. The eleventh session of the COP 11 /MOP 1 initiated a process to consider further commitments by inviting Parties to submit to the UNFCCC (United Nations Framework Convention on Climate Change) Secretariat their views on further commitments by March 2006. Difference of opinion among countries regarding binding commitments under the Kyoto Protocol as well as non-binding dialogue for long-term cooperative actions was observed in COP 11. A parallel process in this regard was suggested under the convention to provide involvement of other countries, including the US and Australia. In order to proceed further with post-2012 framework, the COP/MOP suggested a dialogue on four broad areas, that is, sustainable development, adaptation, technology, and market-based opportunities. These dialogues provide a platform to the Parties to bring out their concerns, priorities, climate change actions, and viewpoints towards a post-2012 climate framework.

The Annexe I countries are trying to use the amendment of Annexe B[3] of the Kyoto Protocol for the further commitment periods as an opportunity to open up the debate for inclusion of major developing countries such as Brazil, China, India, Mexico, and South Africa. Inclusion of these developing countries in Annexe B is also cited by many as a motivation for the US to agree to quantitative emission reduction commitments. The growing economies of these developing countries and the increasing GHG emissions therefrom are the major reasons cited by the developed countries to demand GHG emission reduction commitment from the developing countries. This article reviews the position of developing countries in the climate change regime vis-à-vis the Annexe I countries and specifically analyses the issues and options in engaging the Asian giants like China and India in the energy and climate debate.

GHG emission trends and future projections

An analysis of percentage changes in CO_2 (carbon dioxide) emissions from fuel combustion in key

[1] This paper is part of a larger energy security project supported by the Nand and Jeet Khemka Foundation.

[2] The countries listed in Annexe I of the United Nations Framework Convention on Climate Change, largely the developed countries.

[3] Annexe B of the Protocol lists out the emission reduction commitments agreed upon by the developed countries.

developing and Annexe I countries has been presented in Table 1. From the table, it is obvious that the changes in CO_2 emissions over the period 1990–2004 in developing countries are much more rapid compared to those in Annexe I countries. There are, however, obvious reasons for such rapid rise in the CO_2 emissions from the developing countries. Much of the economic development in Annexe I countries has been achieved, whereas in developing countries economic growth and development process have set in only recently. Another point to be noted here is that even though the percentage changes in developing countries may be higher, the absolute changes are still much lower, except for China, compared to the absolute emission in EU-15, Japan, or the US, as can be seen in Figure 1.

The UNFCCC, through Article 3.1, lays great emphasis on principles of equity, common but differentiated responsibility, and respective capabilities. Based on these principles, developing countries were exempted from any emission reduction commitments under the Kyoto Protocol. A comparison of per capita emissions of China and India with Japan and the US is shown in Figure 2. From the figure it can be seen that the per capita emissions in China and India have been much lower than those in Japan and the US. The projected per capita emissions in 2030 show that emissions in China will surpass the world average while those in India are much lower than the world average at present. This is despite the projected high rate of economic development in India.

Table 1 Percentage change in CO_2 (carbon dioxide) emissions in key developing and Annexe I countries over 1990–2004

Country	*Percentage change in CO_2 emissions over* 1990–2004
Brazil	67.8
China	108.3
India	87.5
Mexico	27.5
South Africa	34.8
EU-15	6.5
Japan	14.8
USA	19.8
World	27.9

Source IEA (2006a)

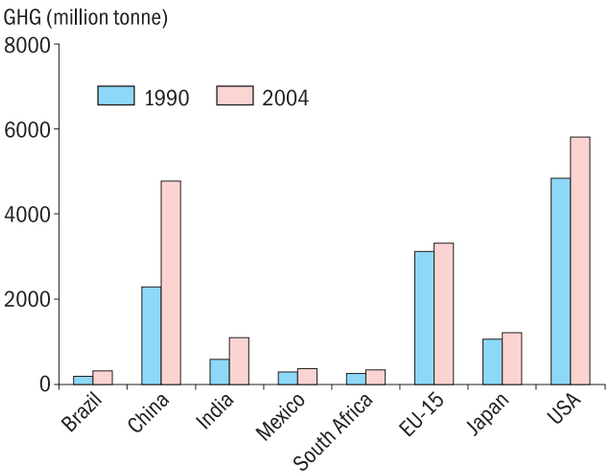

Figure 1 Trend in CO_2 emissions (1990–2004)

GHG mitigation: call for action

Two important reports have been published in 2006 and 2007. These are the *Stern Review on the Economics of Climate Change and the IPCC Fourth Assessment Report*. Both reports have, by highlighting the enormity of the climate change challenge, contributed significantly to an increased public debate on the issue. The reports also present a review of the costs of stabilization of GHG concentrations in the atmosphere, and present an optimistic view that through introduction of appropriate policies and measures, the adverse impacts of climate change can be addressed.

Key highlights of the Stern review

The *Stern Review on the Economics of Climate Change* brought out in 2006 examined the

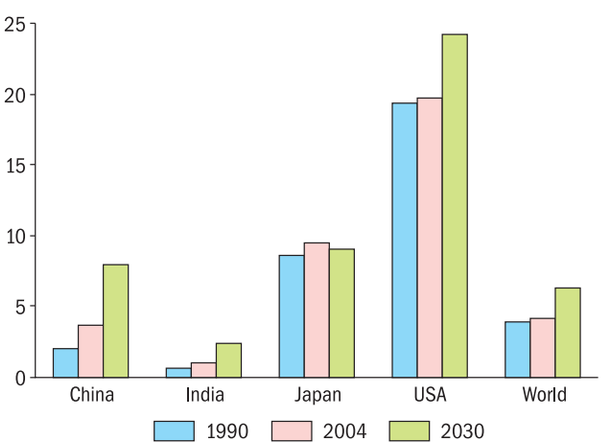

Figure 2 Trend in per capita emissions

Source IEA (2006b)

evidence on the economic impacts of climate change, and explored the economics of stabilizing GHG concentrations in the earth's atmosphere. According to the review, climate change threatens the basic elements of life such as access to water, food production, and health of people the world over. Further, the impacts of climate change are not evenly distributed—the poorest countries and people are predicted to be the most vulnerable.

The review focused on the feasibility and costs of stabilization of GHG concentrations in the earth's atmosphere in the range of 450–550 PPM (parts per million) CO_2e (carbon dioxide equivalent). Stabilizing at or below 550 PPM CO_2e would require global emissions to peak in the next 10–20 years, and then fall at a rate of at least 1%–3% per year. By 2050, global emissions would need to be about 25% below the current levels. These cuts will have to be made in the context of a world economy in 2050 that may be three to four times larger than today. Therefore, emissions per unit of GDP (gross domestic product) would need to be just one quarter of current levels by 2050. To stabilize at 450 PPM CO_2e, without overshooting, global emissions would need to peak in the next 10 years and then fall at more than 5% per year, reaching 70% below current levels by 2050.

Achieving these marked cuts in emissions, however, does come with a cost. The review estimated the annual costs of stabilization at 500–550 PPM CO_2e to be about 1% of GDP by 2050—a level that is significant but manageable. Resource cost estimates suggest that an upper bound for the expected annual cost of emission reductions consistent with a trajectory leading to stabilization at 550 PPM CO_2e is likely to be about 1% of GDP by 2050.

Key highlights of IPCC Fourth Assessment Report

The IPCC recently released its Fourth Assessment Report. The report highlights the facts that the warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global mean sea level. According to the report, 11 of the last 12 years (1995–2006) were among the 12 warmest years in the instrumental record of global surface temperature (since 1850).

Most of the observed increase in globally averaged temperatures since the mid-20th century is *very likely* due to the observed increase in anthropogenic GHG concentrations. This is an advance since the Third Assessment Report, which concluded that 'most of the observed warming over the last 50 years is *likely* to have been due to the increase in GHG concentrations'. Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes, and wind patterns.

The IPCC further underscores with high agreement and much evidence the fact that global GHG emissions have grown since pre-industrial times, with an increase of 70% between 1970 and 2004. With current climate change mitigation policies and related sustainable development practices, global GHG emissions will continue to grow over the next few decades. According to the bottom-up and top-down studies reviewed as part of the IPCC process, there is substantial economic potential for the mitigation of global GHG emissions over the coming decades, that could offset the projected growth of global emissions or reduce emissions below current levels. New energy infrastructure investments in developing countries, upgrades of energy infrastructure in industrialized countries, and policies that promote energy security, can, in many cases, create opportunities to achieve GHG emission reductions.

A review of the macro-economic costs of stabilization of GHG concentrations at different levels is presented in Table 2. These costs are global average for least-cost approaches from top-down models and do not include co-benefits and avoid climate change damages.

The Asian giants: an overview

While the demand for engaging major developing countries in the energy and climate debate is on the rise, it may be worthwhile to examine the case of China and India, the Asian giants under consideration in this paper—their socio-economic status, developmental challenges, and placement in the energy and climate debate.

Table 2 Macro-economic costs of stabilization of greenhouse gas concentrations

Trajectories towards stabilization levels (PPM CO_2-e)	*Median GDP reduction* [a] (%)	*Range of GDP reduction*[b] (%)	*Reduction of average annual GDP growth rates*[c] (percentage points)
590–710	0.2	–0.6–1.2	< 0.06
535–590	0.6	0.2–2.5	<0.1
445–535[d]	Not available	< 3	< 0.12

GDP – gross domestic product; PPM – parts per million; CO_2e – carbon dioxide equivalent

Source IPCC (2007)

Notes

[a] These are global GDP-based market exchange rates.

[b] The median and the 10th and 90th percentile range of the analysed data are given.

[c] The calculation of the reduction of the annual growth rate is based on the average reduction during the period till 2030 that would result in the indicated GDP decrease in 2030.

[d] The number of studies that report GDP results is relatively small and they generally use low baselines.

Socio-economic overview of China and India

China and India are the world's two most populous countries with a population of about 2.4 billion in 2005. Despite the declining rate of population growth experienced by these countries in the recent past, their contribution to the world population has remained more or less constant at about 37% during the period 1990–2005 (ADB 2006).

Both these countries have recorded impressive growth rates in the recent past, with their GDP growth rates averaging at about 8% and 10% for India and China, respectively, for the period 2003–05 (Table 3). The upward trends in the economic growth rate exhibited by these two countries are the result of an increased investment rate, expansion of domestic demand, upsurge in the exports of goods and services, etc. While in India, the contribution of the services sector to the aggregate GDP is the highest, in China the industrial sector continues to be predominant contributor to total GDP. However, both these economies are witnessing similar structural changes in the form of increased share of GDP contributed by the services sector in the aggregate GDP.

Table 3 Trend of GDP growth rate for India and China

Year	*India*	*China*
2000	4.4 %	8.0%
2001	5.8 %	7.5%
2002	3.8 %	8.3%
2003	8.5 %	9.5%
2004	7.5 %	9.5%
2005	8.4 %	9.9%

Source ADB (2006)

The urban areas of both these countries have witnessed higher economic growth relative to the rural areas, leading to rural–urban disparities. In India, the indicators of rural–urban disparities such as per-capita consumption expenditure, employment indicators, incidence of poverty, access to electricity, shelter and quality of housing, sanitation, access to safe drinking water, and road connectivity reiterate, the fact that the gap between rural and urban areas is widening (GoI 2002). This is one of the primary reasons for high levels of urbanization in India with about 28% of the population residing in urban areas in 2005 (ADB 2006).

Similarly, in China, the income gap between the rural and urban residents has kept growing, and China has become one of the countries with the largest urban–rural gap in the world (CCAP 2006). Rural–urban labour migration in China nowadays is accelerating at a much faster pace, thereby becoming one of the most important social factors. In China, the share of urban population to the total has increased from 36% in 2000 to 43% year 2005.

Energy as an imperative for development

Energy is key to the growth and development of a country. This is critically important for countries that are witnessing a rise in their economic development. Poverty reduction and provision of basic amenities to citizens are the key challenges facing China and India, and only economic development provides a solution to these challenges. This would mean increased energy demand from these countries. Energy is also required to meet the targets set up by these countries under the MDGs (Millennium Development Goals) adopted at the UN Millennium Summit held in Johannesburg in September 2000 for improving the condition of the world's poorest by 2015.

Similarly, the high growth rates of GDP have resulted in increased output of goods and

services and have a direct bearing on energy consumption. Figures 3 and 4 reflect the linkage between provision of electricity, HDI (Human Development Index), and economic growth.

The challenge confronting these economies is to meet the development aspirations of their people by way of providing adequate and equitable access to basic amenities and services. Over the years, both China and India have made substantial progress in social welfare with the HDI increasing from 0.515 and 0.628 for India and China, respectively, in 1990 to 0.611 and 0.768 in 2004 (UNDP 2006).

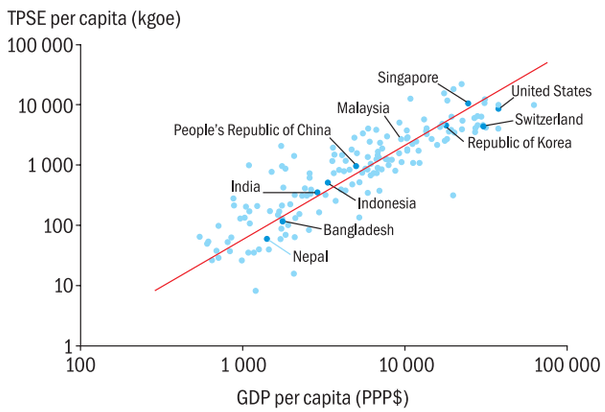

Figure 3 Commercial energy consumption and gross domestic product (2003)
Source World Bank (2006); ADB (2007)
GDP – gross domestic product; kgoe – kilogram of oil equivalent; PPP – purchasing power parity; TPES – total primary energy supply

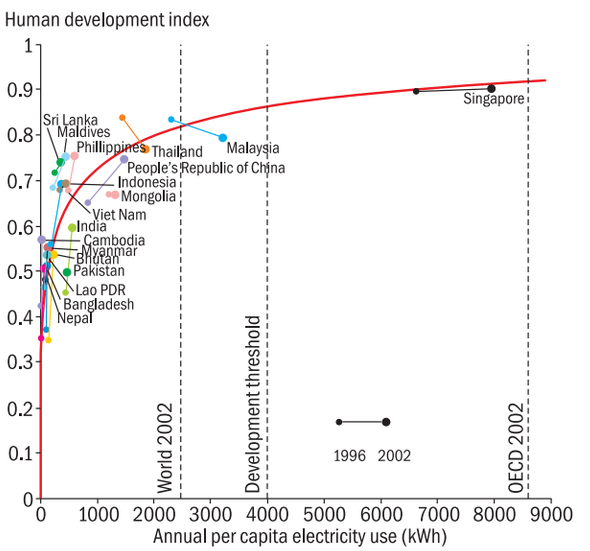

Figure 4 Developing Asia's human development index and electricity use (1995 and 2002)
Lao PDR – Lao People's Democratic Republic; OECD – Organisation for Economic Co-operation and Development
Source UNDP (2006); ADB (2007)

Trends in energy and GHG emissions in China and India

The historical trends reveal that India's TPES (total primary energy supply) has increased from 362 MTOE (million tonnes of oil equivalent) in 1990 to 573 MTOE in 2004 with an average annual growth rate of 3.6% a year during the period 1990–2004. On the other hand, during the same period, the TPES in China has grown from 867 MTOE in 1990 to 1609 MTOE in 2004, with an average annual growth rate of 4.5% (IEA 2006a). As China and India are on a high economic growth, their energy needs are expected to rise in significant proportions in the future. In the global context, India and China contribute about 5% and 14%, respectively, of the world's TPES. However, the per-capita TPES is of the order of 0.53 TOE/capita/annum and 1.24 TOE/capita/annum, respectively, in the year 2004—that is below the world average of 1.77 TOE/capita/annum for the same year (IEA 2006a). A noticeable feature of the energy sector in India and China is the dominance of coal in the TPES, contributing more than half of their TPES. It is expected that coal will remain the highest contributor to energy supply.

The Initial National Communication of People's Republic of China reported that China's GHG emissions in 1994 were 3650 $MTCO_2e$ (million tonnes of carbon dioxide equivalent), with CO_2 accounting for 73% of the total GHG emissions (NDRC 2004). Similarly, according to India's Initial National Communication, GHG emissions were 1228.54 $MTCO_2e$ in 1994, with CO_2 accounting for 65% of the total GHG emissions (MoEF 2004). In both these countries, fuel combustion is the major source of CO_2 emissions.

It is claimed that India and China are now among the top five CO_2 emitters of the world, accounting for 22% of the world-energy-related CO_2 emissions (IEA 2006a).[4] During the period 1990–2004, CO_2 emissions from fuel combustion

[4] The estimates of carbon dioxide emissions from fuel combustion presented in IEA (International Energy Agency) publications are calculated using the IEA energy data and default methods and emission factor from IPCC Guidelines. Emission factor for a same fuel may vary with geographical locations.

from India and China have increased by 87% and 108%, respectively (Table 1). The good signal, however, is that CO_2 emission intensity of both the countries is exhibiting a declining trend and there is a need to continue on this trend.

GHG mitigation efforts of China and India

Keeping in view the growing economies and rising emissions from China and India, it is imperative that these countries start responding proactively to the climate change challenge. At the same time, we cannot ignore the particular situation of the two countries characterized by the developmental challenges faced by them. Any strategy or measure for addressing climate change that stalls the development in these countries will have far-reaching impacts in making the future generations even more vulnerable to climate change. The best way to deal with this dilemma is then to integrate climate change concerns into current development policies and programmes.

In fact, a number of programmes are already going on in China and India that also contribute to GHG emission reduction. In case of China, such measures include restructuring the economy; promoting technology advancement and improving energy efficiency; optimizing energy mix by developing low-carbon options and renewable energy; launching nationwide tree planting and afforestation campaign; and enhancing ecological restoration. In addition, China has also worked on to strengthening laws and regulations, and policies and measures relevant to addressing climate change; improving institutions and mechanisms; and attaching importance to climate change research, capacity building, education, training, and public awareness on climate change.

In India, significant developments have taken place in the promotion of renewable energy, improving energy efficiency, power sector reforms, energy and infrastructure development, cleaner and lesser carbon-intensive fuel for transport, including biofuels and environmental quality improvement, etc. The developments on the policy and regulatory front include Energy Conservation Act, 2001, the Indian Electricity Act, 2003, the National Environment Policy of India, 2006, which identifies climate change as a severe threat and the Integrated Energy Policy, 2006, which provides a broad overarching framework for guiding the policies governing the production and use of different forms of energy from various sources.

Realizing the enormity of the climate change challenge and with a view to accelerate actions for addressing climate change, China has come out with a National Climate Change Programme this year. According to this programme, China will strive to control its GHG emissions, enhance its capacity to adapt to climate change, and promote the harmonious development between economy, population, resources, and the environment. In order to achieve the above objectives, China will be guided by the following (NDRC 2007).

- Giving full effect to the scientific approach of development
- Promoting the construction of socialist harmonious society
- Advancing the fundamental national policy of resources conservation and environmental protection
- Controlling GHG emission and enhancing sustainable development capacity
- Securing economic development
- Conserving energy, optimizing energy structure, and strengthening ecological preservation and construction
- Relying on the advancement of science and technology
- Enhancing the capacity to address climate change

For giving special attention to the climate change challenge in India, the Union Budget 2007/08 of the Government of India announced the appointment of an expert committee to study the impacts of climate change on India, and identify measures to be taken to address these impacts. As a follow up, an expert committee on the impacts of climate change has been set up under the chairmanship of the Principal Scientific Advisor to the Government of India. To further gear up climate change response activities in India, the Government of India has also announced the constitution of a high-level advisory group on climate change on 5 June 2007, also known as Prime Minister's Council on Climate Change or the National Council on Climate Change. The Council will coordinate national action plans for assessment, adaptation, and mitigation of climate

change. It will advise the government on proactive measures that can be taken by India to deal with the challenge of climate change. It will also facilitate inter-ministerial coordination and guide policy in relevant areas (The Hindu 2007).

The first meeting of the Prime Minister's Council on Climate Change took place in July 2007 in which the Prime Minister directed the Planning Commission of India to incorporate clean development strategies into the sectoral plans and proposals for the Eleventh Five-year Plan and make a strategy to deal with climate change as an intrinsic part of the Eleventh Plan. The meeting decided that a national strategy paper on climate change will be prepared before the end of the year. It would protect India's developmental goals and interests while at the same time addressing concerns, both at home and abroad, with respect to global warming and sustainable development (PIB 2007).

Conclusion

The causes and consequences of climate change are global , and therefore, require an international collective action in driving an effective, efficient, and equitable response to address the adverse impacts. Climate change poses a major challenge to scientists and policy-makers in exploring deeper international cooperation in many areas—technology research, development and deployment, and promoting adaptation to climate change, particularly for developing countries. Cooperation could have several dimensions: North–South and South–South. In addition, several indigenous options and measures would need support for large-scale adoption and replication.

China and India are quite significant players in the energy and climate debate in view of their growing economies and the associated emissions therefrom. It becomes important that climate change concerns are integrated into their developmental planning so that GHG emission intensity in these countries can be reduced. Making development more sustainable by adopting low-carbon development paths can make a major contribution to climate change mitigation, but implementation may require additional resources to overcome different barriers and here the support of Annexe I countries could work as a catalyst. There is a growing understanding of the possibilities to choose and implement mitigation options in several sectors to realize synergies between sustainable development and climate change and probably this is the most plausible way in which developing countries, even large ones like China and India, can contribute in addressing climate change.

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Contextualizing Sino–India cooperation

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With the reformulation of India–China relations from the 1988 'cooperative and constructive' security strategy to the April 2005 (reiterated in November 2006) 'strategic partnership and cooperation', bilateral cooperation between these two countries is expected to expand from the regional to global arena to encompass several unexplored areas. For sure this is not the first time that India–China cooperation has exhibited a larger canvas, with such experiments dating back to the 1940s and 1950s. Specifically, cooperation in the Bandung conference, support to Afro-Asian anti-colonialism, and the like are notable. Yet, India–China cooperation in the current phase is qualitatively different from that of the previous period in several respects. The inexorable ground realities of today are unfolding chances for several possibilities of greater cooperation between the two countries than ever before.

First, the two countries have consolidated over a period of more than five decades. Specifically over the last two decades, both have been 'rising' in hard and soft power indicators, including in economic and military aspects. For instance, despite the prevalence of more than 500 million people under poverty levels, China and India posted impressive economic growth rates, thus raising GDP (gross domestic product) to about $2.4 trillion and nearly $900 billion, respectively, and became the second and third largest economies in Asia, after Japan. China became the manufacturing hub of the world, while India carved out niche areas in information technology, service sectors, and others. Both have also become explicitly nuclear and have channelized part of their rising GDP figures into the defence sector, specifically in power projection forces like ballistic missiles, air, and naval forces. What these and other related areas of economic, technological, and military developments in India and China indicate is that they have become forces to reckon with vis-à-vis each other (in terms of a notional strategic parity) and in Asian affairs and beyond. While India (and Myanmar) played such a political role in the 1950s as compared to the yet-to-be-recognized China, now the latter appeared to have already 'emerged'—howsoever in seeming conflict with the US and its allies in Asia.

Second, unlike the 1950s when a 'microscopic minority' of the political elite in both countries managed bilateral interactions, currently a wide spectrum of opinion has to be considered or taken into account in the decision-making processes of both the countries. Traditionally, the Chinese military, which held sway over large tracts of western areas (contiguous to India and other South Asia states), used to exercise a decisive say in the South Asia policy. The Chinese military took a hard position on issues related to the border dispute with India and on the Tibet issue, while supporting Pakistan and other South Asian countries to counter India during the Cold War years. To be sure, the military perspective towards this region still continues in China's national policy. Yet, new pressures from the industry and commercial lobby, people-to-people contacts, imperatives of countering terrorism in Xinjiang, nuclear stability in the region, and the like have contributed to the current nuanced policy of China. A Western Development Campaign was launched by China to open up about 16 interior provinces and regions of China for investments and infrastructure development projects. This resulted in the construction of the East–West energy pipeline connecting Shanghai to Urumqi (and extended to Kazakhstan), Tibet railway line, and about 22 000 km of roads in Tibet alone; support to sub-regional cooperation like that of the 'Kunming Initiative'; and exploration of free trade area (successful with Pakistan in November 2006

[1] http://www.jnu.ac.in/faculty/srikanth/

but under discussions with India). Clubbed with the $25 billion in bilateral trade volume value in 2006 and estimated $1 billion in investments (mostly – about $950 million – from India), the influence of the industry and commerce appeared to be on the upswing in the decision-making process of both countries. In addition, an estimated 450 000 Chinese visited India last year. The officially sponsored 'friendship' and 'tourism' years may also have contributed to this surge in contacts.

Another facet of cooperation between the two countries is the growing understanding on counter-terrorism aspects, with the two identifying this issue as a national priority to tackle with. Obliquely referred to first by visiting Chinese leader Li Peng in 2001, counter-terrorism cooperation has been expanding between the two countries with the November 2006 joint statement mentioning the need to oppose the 'three evils' (separatism, extremism, and splittism), joint intelligence sharing, and possible joint exercise in the near future between the two armies (as decided during the Indian Army Chief's visit to Beijing in May 2007). On nuclear cooperation as well, despite the Chinese opposition to Indian nuclear tests of 1998 and the subsequent support to the UNSC (United Nations Security Council) Resolution No. 1172, the joint statement of November 2006 calls for cooperation in civilian nuclear spheres. On the Chinese support to Indian candidature for the permanent seat in the UNSC, while China has been vague or even in opposition earlier, there have been some positive signals from Beijing of late.

Third, as multilateralism has become a major phenomenon in the post-Cold-War era, India–China cooperation is gradually being expressed through these institutions. While India became an observer in SCO (Shanghai Cooperation Organization) at the Astana Summit in 2005 and a member in the EAS (East Asian Summit) at Cebu in January 2007, China became an observer at the 14th summit of SAARC (South Asian Association for Regional Cooperation) in April 2007. However, these entries are not without hiccups, with China either giving lukewarm response or even opposing the Indian entry in SCO or EAS, while India wanted China to first sign bilateral MoUs (memoranda of understanding) with the South Asian countries before contemplating to join the SAARC. In general, China had, from 1927, utilized these institutions as a form of 'united front' with like-minded parties against common adversaries or for rallying for common objectives with the caveat that Chinese leadership issues in multilateral fora are of paramount importance. It needs to be seen how the November 2006 India–China joint declaration that called for 'close cooperation' between the two in the Asian region will unfold in future.

The contours of 'strategic partnership and cooperation'

Nevertheless, this raises the issue of 'strategic partnership and cooperation' and its contours between India and China. As mentioned before, both India and China subscribed to 'strategic partnership and cooperation' first in April 2005. The path towards strategic partnership and cooperation has not been made explicit by both countries and appears to be in the making. China, for itself, has signed over a dozen such agreements with several countries, including with Russia, the US, European Union constituents, Brazil, and Indonesia. Of these, the Chinese consider the Sino-Russian agreement of 2001 as 'strategic' for several reasons. Most importantly Chinese contend that article 9 of the agreement provided possibilities for mutual security (much like the same article in the Indo-Soviet Treaty of 1971!), which, in turn with the border agreement, could pave the way for 'permanent peace' between the two countries. Indeed, the current levels of relations between these two countries are said to be strategic in content—long term in nature, cooperation at the global levels (such as at the UNSC as reflected in the opposition to the US war on Iraq in 2003 or the January 2007 veto on the issue of Myanmar, or joint efforts in the Darfur crisis in Sudan, and so on), and intensive military cooperation (as reflected in the August 2005 joint exercise in Vladivostok and Shandong Peninsula and arms transfers).

In this context, are the relations between India and China, then, 'strategic' in nature? First, we need to examine the respective 'strategic interests' of both India and China and whether there is a possibility for both coming together in a cooperative mould in these spheres. The issue of 'strategic interests' in the India, China context

should consider the following: both are heavily populated, developing economies and societies, sharing a large undefined and un-demarcated border of about 3500 kilometres and have initiated the process of enhancing their comprehensive national power indices. As rising economies, both have aspirations for resources and markets at the global levels. Yet, both face similar national challenges: poverty, illiteracy, disparities in incomes, social unrest, and so on. At the national security level, both have configured terrorism as a major challenge, while at the international level any pressure to reduce or stultify their sovereign independence or freedom of judgement and action is frowned upon. In the Chinese case, a revised national strategy called for stopping Taiwan's 'drift towards independence'. Both would like to fashion a more equitable international world order, and in the Indian case from 2001, promoting democracy. India, by the February 2001 Group of Ministers resolution, expanded national security interests from the Persian Gulf to the Straits of Malacca's, with the 'extended neighbourhood' up to the Central Asian Republics. China, on the other hand, by the 1992 resolution extended its national security perimeters to 200 nautical miles and made efforts to extend up to the so-called Second Island Chain ranging from the Kurile Islands in the north to roughly at the edge of the West Pacific. In addition, China aspires for strategic frontiers (land, sea, air, space, and electro-magnetic spectrum) as the 11 January 2007 anti-satellite test, and other related events indicated. On these issues, there are several areas of convergence and divergence, prospects, and challenges between India and China and interactions between the two in future could unfold either of these. Foremost, both expressed the view that cooperation and coordination are needed in the UN (United Nations), WTO (World Trade Organization), energy and environmental issues. Yet, both are likely to compete for resources and possibly view each other's equations with major powers in suspicion and activity in some areas like South China Sea (of Indian naval exercises) or Indian Ocean (through China's 'string of pearls'), and so on as possible areas of conflict.

However, it needs to be reiterated that there is no doubt that the bilateral relations have acquired strategic dimensions with the above changes that occurred in both the countries. India and China are now not confined to South Asian or East Asian boxes, but their influence and reach extends far beyond, although the US is still the pre-eminent 'hyper' power. Vis-à-vis each other both now recognize this new dynamic, with India under Nehru recognizing as such in the 1950s itself, while in the Chinese case it has been a belated move to recognize the Indian role in the international arena. China's Cold War engagement with the US in 1971/72 and in the post-Cold-War 1998 efforts was indeed to confine India to the South Asia box. Still, some Chinese argue for following a policy of 'uniting with small countries (say Pakistan, Bangladesh, and so on) to counter the big (say, India)' (*hexiao, gongda)* in South Asia. However, the recent Chinese perceptions about India's rise, changes in the US policies towards South Asia in general and India in particular, and formulations about the 'arc of destabilization' extending from Central Asia, Afghanistan, and Pakistan to Myanmar (and lately including Bangladesh and Nepal—incidentally all these countries are supported by China!) have all led to the recent changes in China's policies towards India.

Incidentally, the Chinese re-assessments of India came in the aftermath of the US efforts at re-organization of the international order with India as one of the countries of attention. Indeed, US Secretary of State Condoleezza Rice mentioned in her Sophia University speech in March 2005 that the US would like to help India become a major power in the world. Subsequently, a defence cooperation agreement for 10 years was signed in July 2005, and an intent for cooperating in the civilian nuclear field is under discussion as a part of the '123 agreement'.

One of the main prerequisites for building strategic relationship is to have political trust between two countries. However, in the case of India and China, this is a major issue today. Indeed, until a few years ago (and continuing), several Chinese leaders (like Li Peng and others) stated that there exists political trust deficit between the two countries, partly fuelled by suspicions of each restricting the other and complicated by historical dynamics between the two (the border clashes of 1962, Tibetan

presence in India, Sino-Pak nuclear and ballistic missile cooperation, China's close interactions in the military field with other South Asian countries, and enhancement in Indian naval reach in the Indian Ocean). In the absence of any major and concrete move to resolve these bilateral differences, the bilateral relations could hardly acquire strategic dimensions. Indeed, much like in the 1950s, bilateral relations could suffer major damages if the bilateral disputes between the two are left unresolved, thus puncturing any possibility of cooperation in the long term or at the global levels, not to mention cooperation in military spheres. Although India and China have launched joint operations (such as between the navies in November 2003 at Shanghai, December 2005 at Cochin, and April 2007 at Qingdao) and introduced other confidence-building measures between the two armies, these are conflict preventive in nature and the next stage of trust building is far away. It also needs to be mentioned here that Chinese elevation of India in the strategic calculus came after elevating the profiles of several other countries such as Bangladesh and Sri Lanka, not to mention the 'all-weather' relationship with Pakistan in China's foreign policy perspectives.

In summary, the above analysis indicates that India–China cooperation is expected to be exhibited in selective areas like economy, energy, environment, and other related issues while other areas are bound to throw up several surprises. While bilateral cooperation is expected to happen in the long term, other areas like political trust, permanent peace and security, and 'jointness' in other international issues are expected to take a long time to fructify. Overall, while the US could make India (through the nuclear deal and other similar agreements) an appendage to its unilateral policies (while at the same time helping India to become a 'major power' much like China), China's conditionalities as a part of the proposed *quid pro quo* on the UNSC seat or other related issues, are also likely to narrow India's avowed ability to 'maintain the freedom of judgement and action'. Both of these issues, then, need to be carefully evaluated and policies formulated in the strategic interests of India.

Joint bidding for overseas oilfield stakes: analytical views[1]

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India and China are witnessing a rapid increase in the demand of energy resources, particularly crude oil. But as these countries are majorly dependent on imported oil and increasingly so from Middle East countries, rising oil prices and increased geopolitical instability have made the issue of energy security acute. India and China need secure and stable supply of energy to pursue their economic and development agenda. Thus, both countries have been trying to reduce their high oil dependency. These measures include investing in overseas oil.

In the search for overseas oil, the state-owned companies from both countries have sometimes been rivaling each other. For instance, in bids for oilfields in Angola, and in the bid for PetroKazakhstan, the Indian public sector firm OVL (ONGC Videsh Ltd) has been outbid by its Chinese counterpart CNPC (China National Petroleum Corporation). But this has cost both the countries, in terms of the high bid-price to China and in terms of resource and negotiation cost to India. So, from 2005, bilateral talks have led India and China to promoting selective cooperation in overseas energy policy. As a follow up in 2006, India and China have jointly invested in an oilfield in Syria.

However, one must look into this matter analytically. The instances of competition emerge from strategic thinking, which is natural

[1] The author thanks Ligia Noronha and Pradeep K Dadhich for useful comments and suggestions in developing this paper.

when nation states are engaged in solving resource problems for their citizens, but the notion of cooperation between these two countries is also strategic and needs formal modelling. In this short article, we will only focus on one strategic aspect, that of joint bidding for acquiring overseas oilfield stakes. We will support this exercise with some technical results obtained from general theory of mechanism design. Also a simple illustration using the famous 'Prisoner's Dilemma' game would help us analyse the mutually beneficial aspect of cooperation over time.

Joint bidding for overseas oilfield stakes: strategic aspects

Investing in overseas oilfields has emerged as a plausible option to enable diversification and provide a risk cover against random supply shocks in major exporting countries. China's CNPC is currently engaged in 30 international exploration and production projects in countries like Azerbaijan, Canada, and Indonesia. OVL of India also has undertaken over 25 projects in countries such as Vietnam, Myanmar, Nigeria, Sudan, Congo, Libya, Brazil, and Cuba. In the overall scenario of equity oil and gas investments, however, China's reach has been greater than that of India.

A note on common value auctions and 'winner's curse'

We note that these auctions of overseas oilfields are generally 'common value' auctions, at least for bidders like India and China. This is because the ex-post value of the oilfield is the same for all bidders. But before the auction takes place, the bidders cannot realize the market value of the oilfield. Thus, naturally while bidding each player bids high—over and above an average level. This is also because bidders do not share information with each other. This overbidding or 'failure to judge the actual value' is termed as 'winner's curse'. In fact, this is very much linked to imperfect information and hence, can be an example of 'adverse selection' problem. Overbidding is aggravated by the competition as well. Since everybody places a sealed bid, each bidder bids aggressively to enhance the probability to win. Thus, the bid price shoots up.

China: subject to 'winner's curse'?

However, if we look at some of the recent ventures by India and China for overseas oilfield, we get a reflection of the above concept. Many oil experts feel that the prices Chinese oil companies have been paying for various oilfield stakes are too high and a result of overbidding. For instance, the deal in PetroKazakhstan was overvalued (India offered $3.8 billion) from the beginning. Later, bidding and counter-bidding raised the sale price to $4.18 billion. A recent bid for acquiring Canadian oil firm Encana Corp's Ecuador assets by Chinese consortium Andes Petroleum Corp. does not include the risk cover against the possibility of expropriation. So the bid was overvalued, as it did not internalize the cost of risk

The above discussion points that China, as an independent bidder, could be a victim of 'winner's curse', but this aggressiveness in China's bidding is also to counter competition from countries like India. This competition between two aggressive bidders is a boon to the seller of the oilfield stake, as it enhances the selling price.

What we would like to highlight is that a non-cooperative approach by India and China ultimately leads to an overpricing of the oilfields and other ventures. Within the framework of non-cooperative games, auction and mechanism design theory provides a rich class of characterizations of joint bidding ventures. We can suitably use them to make a case for India–China cooperation with regard to joint venture for overseas oilfield acquisitions.

Theoretical point of view

Here we present some theoretical results, which can be linked to the above and can highlight the policy implications.

DeBrock and Smith (1983); Hendricks, Porter, and Tan (2000); and so on discussed the mitigation of 'winner's curse' from an informational point of view. Before bidding, each bidder undertakes a geophysical search, which measures an expected 'tract-value'. When a group of bidders is formed, they can pool the results of the independent tests and get a concrete idea about the actual valuation of the object to be auctioned. Thus, the possibility of overbidding due to lack of knowledge is taken

care of to some extent. (However, this 'pooled information' can sometimes lead to more aggressive bidding but we will not consider that for the case where only two bidders (India and China) are there. We will revert to this later on.)

Thus, benefit of cooperation can be realized from both aspects—it reduces competition and thereby chance of overbidding and it also helps the agents in dissemination of information, which in turn gives a clearer picture of the valuation of the object. This shows the existence of a 'win-win' opportunity in strategic mutual cooperative behaviour.

A note on 'net effect' of joint bidding: India–China case

It has been argued by DeBrock and Smith (and many others) that joint bidding has two parallel effects on an industrial organization. On the one hand, it helps in pooling information about a priori unknown tract values and thereby reduces the chance of overbidding. On the other hand, it allows for entry of many small firms that would otherwise be excluded because of cost of capital, and so on, which again enhances degree of competition in the market. Thus, the net effect on the bid value is ambiguous. But in our paper we are considering those deals where India and China are major players and situation is unlikely to change even if India and China bid jointly. That is, their merger will not attract any new potential buyers to the bidding process. So we can assume that above effect will be null or negligible.

The model

We formulate the auction mechanism formally. Here, we consider India and China involved in bidding process for an overseas oilfield stake. Let us first define the variables.

Z_i: bid by country i; i= India, China
V: value (of the oilfield) statistic, which is a random variable

G (Z|V): distribution function for bid statistic conditional on value statistic V
$X = \max \{Z_1, Z_2\}$: highest bid statistic
H (X|V, n): Distribution function for highest bid statistic conditional on value statistic and number of bidders, n. So $H(X|V, n) = [G(X|V)]^2$
[Note that we have assumed that bid statistics for two countries are independent, which is likely as they are competing and exchanging no information.]

Differentiating the above distribution function, we get the density function for highest bid conditional on value and number of players.

$$h(X|V, n) = 2g(X|V).\ G(X|V)$$

So, loosely the above function h( ) gives the probability for highest bid value given the valuation of the oilfield and the number of bidders, which in this case is 2. However, given a probability measure over bid values P(V), we can get the joint probability distribution of bid value and highest order bid conditional on number of players.

$$F(V, X|n) = P(V).\ h(X|V, n)$$

This follows directly from Bayes' Theorem.

Now we are in a position to define a country's objective function.

Given a probabilistic structure, every country will try to maximize its expected net surplus from the bidding. As the country has to pay only if it wins the bid, the expected net surplus would be

$$E(\pi(b)) = \int f(V-b)\left(\int f(V, X|n)\, dX\right)dV \ldots\ldots\ldots\ldots\ldots\ldots (i)$$

Here b is the highest bid by the country and the inner integral ranges from 0 to b. Then, $\int f(V, X|n)\, dX$ gives the probability that b is the highest bid. Naturally then the above expression gives an expected net surplus from the bidding and the country maximizes (i).

We must note here that generally the bid statistic Z is assumed to follow unbiased Weibull distribution because of its flexible statistical properties. However, here we mention the most important assumption in this model, which in fact captures the importance of 'Information' about the value statistic V. Formally, we assume that

$$G(Z|V^*) < G(Z|V^{**}); \text{ for all } Z, \text{ with } V^* > V^{**} \ldots (ii)$$

This implies that when value of the oilfield (V) is higher, upper bound on distribution of Z rises.

So if signal about the value of the oilfield is on the higher side, there is a tendency to bid higher. However, let us now look at the optimal solution given by the maximization of (i).

Optimal bid (b*) that results from maximization of (i) will satisfy the following as obtained by the first-order condition.

$$E(V|b^*, n) - b^* = \{\iint f(V, X|n)\, dV\, dX\} / \{\int f(V, b^*|n)\, dV\} \quad \text{(iii)}$$

Right hand side of (iii) is ratio of two probabilities (in fact, it is a probability depicting the failure rate of b*) and thus is positive. So, the optimal bidding strategy is that bid value (b*) should always be below the expected value of the oilfield *after winning the bid*. This is again a very crucial point to note. $E(V|b^*, n)$ is the posterior expected value of the oilfield, that is, it internalizes the information that other bidders have not given higher bids. So, just bidding below the ex ante expected value of the oilfield is not sufficient! On the whole, the optimal strategy given above asks a bidder to follow underbidding to minimize risk.

The above analysis shows that a country can be subject to 'overbidding' if it does not adhere to such an optimal behaviour, which also follows from (ii). Clear policy implication that comes out is that there should be a positive margin between expected value (ex-post) of the oilfield and the bid value.

India–China strategic interactions: Prisoner's Dilemma?

In terms of interactions in the energy market, particularly in acquiring overseas oilfields, the question that arises is: are India and China engaged in a Prisoner's Dilemma type of game? We can see that though here pay-offs do not exactly map to a classical Prisoner's Dilemma game, analytically they are similar. Let us explain. If the countries compete over an oilfield, both have to spend some resources in order to enhance the probability to win. But if one has the attitude to cooperate while the other is in a competitive frame, the former has nothing to lose but the latter gets a walkover. This definitely gives the latter extra competitive benefit! Naturally if both cooperate then they get more or less equal profit. Following the above discussion it is clear that non-cooperation between the two countries leads to a competitive solution, which is Pareto Inefficient. We know that in a Prisoner's Dilemma game, it is every player's dominant strategy to defect (non-cooperation). With some arbitrary pay-offs, let us present the game form.

	Cooperate	Defect
Cooperate	5, 5	0, 15
Defect	10, 0	0, 0

Clearly 'both countries defect' is the self-enforcing Nash equilibrium in this game, since 'defect' is dominant strategy for both the players. We can make the conjecture that conflicting interactions between India and China are also subject to this outcome only. But in the long run, one can obtain 'cooperation, cooperation' as an outcome following a pact between the players with an in-built mechanism of punishment for deviation from it. This is the famous 'Folk Theorem' in repeated game theory literature.

We can comment that in future if India and China plan to engage in a bidding process of overseas oilfields *repeatedly*, the above analysis implies that cooperation is a feasible outcome, given some commitments from the two countries. As there will always be a tendency to cheat in this kind of a game structure, the stability will depend on the 'punishment strategy'. The above analysis suggests that cooperation between India and China in overseas oilfield auction processes may be mutually beneficial.

Conclusion

Cooperation between major oil-importing countries is key to addressing increased world oil needs. Regional cooperation has been advocated in order to strengthen bargaining power, to stabilize regional oil markets, and to shield against uncertainty in future. We argue with some established findings from auction theory literature that in a bidding process, India–China cooperation can create a 'win-win' situation. This primarily results from the alleviation of 'winner's curse' by group

formation. We then put this strategic interaction in the Prisoner's Dilemma framework and argue for cooperation over time through a binding agreement.

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India–China energy cooperation

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Introduction

The global energy scene has witnessed certain key developments in this millennium. Foremost among them is the realignment of the global energy markets shifting the centre of gravity to Asia. The four major Asian consumers – China, India, Japan, and South Korea – together guzzle over half the oil produced in the world. China and India, particularly, have propelled themselves onto a growth trajectory fuelled by an enormous and growing thirst for energy—thirst that cannot be quenched by their domestic reserves alone. China is expected to clock annual GDP (gross domestic product) growth rates of at least 8% during the remaining years of this decade, much of it fuelled by concomitant rise in energy consumption. China's oil consumption has been growing far more rapidly during the last two years—at 11.3% in 2003, 15.5% in 2004, and 9.5% in 2005.

The Indian economy, equally energy-intensive, expects 7%–8% growth during this decade. Once again, it will be fuelled by about 7%–8% growth in energy consumption. Thus, energy demand from both the Asian countries is slated to grow at about 8%–9% during the remaining years of the decade.

The second most important development on the global energy scene is the surge in oil prices. Fuelled by panic over peaking oil, and stoked by speculation, the already tight oil market has been behaving erratically. After hurricanes Katrina and Wilma, large refining capacities went out of the market, leading to a razor-edge balancing of oil product demand and supply. Asia's apparently insatiable oil demand has all but exhausted any spare crude oil capacity that had enabled Saudi Arabia to 'swing' its production and stabilize prices. For the present, soaring crude oil prices seem irreversible and the world has moved ineluctably to a higher oil price trajectory in the last few months.

The third development on the Asian energy scene is the growing importance of natural gas in the energy baskets of nations. Kyoto signatories, China, India, Japan, and South Korea are increasing the share of gas – by far, the cleanest of fuels – in their economies. Japan and South Korea,

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of course, have been pioneers in the use of LNG (liquefied natural gas), but now China and India have joined the gas bandwagon, also encouraged by availability of abundant reserves in their neighbourhood. The ease, convenience, and declining cost of LNG is making it an attractive alternative to piped gas in the region. It is against this backdrop that this article examines the scope for the two rising Asian economies – China and India – to cooperate in the energy sector.

Challenges, synergies, and dissimilarities

Conventional wisdom posits India and China as two rivals, competing for limited global resources to uplift the standard of living of their teeming millions. Despite this perception, it needs to be remembered that China and India have fought, one war in the early 1960s, and for the next four decades, have focused on growth and development rather than on armed conflicts. Besides, pursuit of energy security need not be a zero-sum game if only we can clearly identify the spheres of opportunity and synergy as well as those of conflict or challenge. The areas of synergy are listed below.

- Both India and China have an acutely energy-intensive growth paradigm.
- Both will be dependent increasingly on imported oil and gas to fuel their economies.
- Both depend heavily on the Persian Gulf region for their imports. While the security of Straits of Hormuz is a joint concern for both India and China, the latter is also concerned about the security of the Straits of Malacca.
- Both are vulnerable to price spikes and volatility. However, India is more vulnerable than China since nearly half of its export earnings are pre-empted by its (petroleum) import bill, whereas for China, exports pay for a much larger share of its energy import bill.
- Both have demonstrated a marked degree of ambivalence about the efficacy of markets as the ideal mechanism for delivery of energy. Therefore, both have been adopting a mercantilist approach to energy security—through half-hearted market reforms and physical control of supplies through equity participation.
- In their quest for diversification, both are turning to their neighbourhood for energy supplies. China's options in this regard are larger for gas as well as oil.
- Both are aggressively pursuing pipeline deals from the neighbourhood. Here, China is in a better position than India.
- Both are setting up strategic reserves to deal with potential oil supply disruptions.

As for the areas of challenge, some of them are issues of perception rather than reality. While now, both India and China are dependent on the Persian Gulf for their oil supplies, the future will see China turning to near-sources such as Russia and Central Asia, freeing up Gulf oil for India. Even if that does not happen, the GCC (Gulf Cooperation Council) region, whose production satisfies a quarter of global oil demand, has adequate supplies to fuel both China and India. This is primarily because Russia is emerging as a substantial supplier of both oil and gas to Europe while North America is increasingly turning to its own continent – notably Canada – as well as Mexico and Venezuela and to Western Africa for its supplies. China's increasing presence in Myanmar and in Pakistan is being viewed with suspicion in some quarters in India. If seen in the context of the acute vulnerability of China's energy supplies in the Straits of Malacca, this move may seem a natural response.

The MoU (memorandum of understanding) signed between the Myanmarese military leadership and China for supply of gas specifies neither quantity nor source nor the price. But subsequently, an agreement seems to have been made on sending this gas to China. However, exploration efforts in the region continue and future gas finds, if any, could be shared between both India and China. Mistrust of each other could be a formidable challenge to effective cooperation. However, if the issue is approached with maturity, understanding, and appreciation of each other's compulsions and imperatives, mistrust could be replaced by cooperation and synergy especially when pursuit of energy security is not a zero-sum game.

Potential areas of energy cooperation

This article examines potential areas of practical and immediate cooperation between India and

China aimed at mitigating their enormous and growing vulnerability.

Joint stockpiles

Both China and India have decided to set up their respective stockpiles—of 45 days in the case of China and 15 days, initially, in the case of India. India has just set up an SPV (special purpose vehicle) entrusted with the task of setting up an SPR (strategic petroleum reserve). According to reports, China has already begun construction of oil-tanking facilities in Zhenhai, in the port city of Ningbo on the eastern coast. China has also earmarked three other sites for strategic stocks along the eastern seaboard, aiming to build a total of 16.2 million cubic metres (101.9 million barrels) of reserves in the next five years. India and China can cooperate in the construction and joint management of crude stockpiles. Joint bidding for construction could bring down the costs. Setting up an SPR cannot be postponed much longer in view of the serious energy vulnerability of the two Asian neighbours. Yet, if India and China place additional demand on the global oil market for filling up their respective SPRs, they could send prices soaring even further in the current volatile market situation. Therefore, both countries will have to look for other alternatives that do not upset the global oil market. Further, both may find it worthwhile to discuss with IEA (International Energy Agency) the possibility of participating in the IEA SPR or that of building a common Asian reserve.

Joint lobbying to de-link natural gas prices from crude oil

It is inevitable that both India and China will see substantial increases in gas consumption in the coming years. While pipelines will supply some quantities of gas to both the countries, LNG is also likely to play an increasingly important role as liquefaction costs are driven down by constantly upgrading technology. Globally, LNG price is linked to crude price—an individual marker or a basket of crudes. In the current scenario of spiralling crude prices, such linkage may render LNG beyond the purchasing capacity of Asian markets, especially China and India. Therefore, if gas suppliers can be persuaded to de-link their LNG price from crude, they would find ready markets in Asia.

Such a gesture would be beneficial to both the gas suppliers and consumers, securing stable and long-term buyers for the former and conversely, affordable and stable supplies for the latter. Gas prices can be linked alternatively to coal or fuel oils, which it replaces. If successful, it could set a new benchmark and enable gas to realize its potential as the fuel of this century.

Asian oil premium

All Asian countries pay a premium of US $1 to 1–50 for each barrel of oil imported from the Persian Gulf, thanks to a historical accident of pricing. Thus, all Asian consumers pay, over and above the high crude prices, a premium that costs them collectively over $10 billion annually. While there has been some discussion among Asian buyers of the need to collectively bargain for elimination of the 'Asian premium', no concrete measures have emerged so far. Proposals for an Asian marker crude – to reflect the heavier crudes consumed by Asia – have not taken off. China and India could push for an overhaul of the international oil pricing mechanism to a less discriminatory and more equitable one. Mutual support for each other's position for the development of an Asian marker crude reflecting the heavier and high-sulphur crudes consumed by Asia is another area of multilateral cooperation in which China and India can take the lead.

There could be no better timing than the present, with the EU (European Union) and the US eager to diversify their sources of imports in the post-9/11 and post-7/7 world, and where increasing Russian and Central Asian oil supplies offer a very attractive alternative.

Collaboration on clean coal technologies

In the second Kyoto commitment phase which will begin in 2012, it is very likely that China, India, and Brazil will also be required to agree to cut emissions, preventing the former two from generously dipping into their substantial coal reserves. In that scenario, it is perhaps inevitable that both these countries will turn to cleaner energy sources to meet their growing electricity

demand. Since both India and China are endowed with abundant coal reserves, it is imperative that both these countries collaborate on using coal in a clean manner. There is an array of new technologies that seek to do this, such as coal gasification, coal to liquids, and coal-bed methane as well as technologies for carbon sequestration. Both China and India have respective strengths in this sphere and by pooling their strengths, they could multiply the advantages. Specific areas of collaboration in research and development can be identified.

Transnational electricity trade

Tajikistan and Kyrgyzstan, the two Central Asian Republics, have substantial hydel potential. Tajikistan has a potential of 263.5 billion-kWh (kilowatt-hours), of which only 6% has been exploited. Kyrgyzstan has 163-billion-kWh potential, of which only 10% has been exploited. The potential in these two countries remains unexploited for want of capital as well as markets. If new hydel projects can be built in these countries, electricity can be transported to India through the Xinjiang district of China. HVDC (high voltage direct current) lines have now made it possible to transmit electricity over long distances with minimal line losses. The Xinjiang route will make it possible for India to bypass Pakistan and reach Himachal or Ladakh in India. No doubt, the lines will have to traverse difficult mountain terrain, but the Power Grid Corporation of India – the country's state-owned transmission company – has demonstrated expertise in building high-voltage transmission networks in difficult terrain. During the Soviet era, all the Central Asian Republics were interconnected through a high-voltage grid, and there was power flow between Russia and the Republics. In recent times, however, the grid has been disconnected and is in disuse although both Kyrgyzstan and Tajikistan supply some electricity to Uzbekistan through cross-border connectivity. It might be worthwhile to explore whether the Soviet period grid connectivity cannot be restored at minimal cost. In fact, in the future, it is also possible to extend the connectivity to Uzbekistan where electricity generated by gas turbines can also be fed into the same grid to be transported southwards to India. China and India can also collaborate in the construction of hydel projects as well as the transmission networks, pooling capital as well as technology. For India, the project will have the added advantage of bypassing the troubled Afghan and Pakistani territory. Additionally, China can earn transit revenues as well as help in the development of Xinjiang. India's new electricity law allows open access to the country's transmission and distribution networks, so much so that the bulk consumers can directly buy power from any producer.

Joint investments in exploration and production

The two countries can also collaborate in joint investments in exploration and production acreages in the producing regions of the world. China and India have been competing with each other to acquire oil and gas acreages in many parts of the world. Competition often serves to push up the prices, as it did in the case of the PetroKazakh properties which both aspired for, whereas collaborative bidding might have the opposite effect. In fact, the efficacy of this strategy is amply demonstrated by the successful joint bid made by India and China for the Syrian asset.

Cross-investments in each other's energy sector

Both countries have opened up their energy sector to overseas investors, although to varying degrees. China is planning to acquire upstream acreages for exploration in India through the NELP (New Exploration and Licensing Policy) licensing rounds. India has demonstrated strengths in building versatile refineries, and Indian investors are exploring overseas investment opportunities. Indian industry could explore the possibility of setting up refineries in China.

Conclusion: the way forward

China and India have already begun to realize the need for collaboration rather than competition in their epic quest for energy security. An indication of this realization is the historic MoU signed between the then Indian minister for petroleum Mr Mani Shankar Aiyar and his Chinese counterpart in January 2006 in Beijing. The agreement envisages comprehensive cooperation in the fields of 'upstream exploration and production; refining and marketing of petroleum products and

petrochemicals; research and development, conservation, and promotion of environment-friendly fuels; trading in oil; and joint bidding in third countries'. The agreement goes as far as setting up a joint committee to monitor implementation and facilitate dialogue and information sharing not only in purchasing energy but in the full spectrum of the hydrocarbon chain. It also includes five commercial agreements between Indian and Chinese energy firms. There has been speculation especially on the part of western observers that the MoU will not translate into anything concrete on the ground and that competition between the two is inevitable. However, in recent times, it is becoming increasingly apparent that China is focused on growth and not on conflict, and any measure or collaboration that will achieve this objective is likely to be pursued vigorously.

For purposeful and fruitful energy cooperation, it is essential to have an institutional framework that can identify the synergies and harmonize the energy policies of the two countries. Since energy is a strategic commodity with political, economic, and security dimensions, a task force comprising members from both countries could be set up to identify areas of collaboration, draw up specific plans and schemes, flesh out the details and modalities, and thrash out the differences. The task force should ideally comprise policy-makers, experts, as well as industry representatives. Political will to move ahead will determine the success of the cooperation.

Two energy dialogues: a report

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With a view to moving the idea of India–China energy cooperation forward, creating an improved environment for energy relations, and articulating specific possibilities for cooperation, the ICS (Institute of Chinese Studies) TERI (The Energy and Resources Institute) in New Delhi and the Shanghai Academy of Social Sciences organized two India–China dialogues on energy issues in New Delhi (10 April 2006) and in Shanghai (15 May 2007). Energy experts and scholars from China and India deliberated on emerging issues in the international oil and gas market and their implications to China and India, and on challenges and opportunities that the energy sector presents to these countries. Institutes that participated in New Delhi included, TERI, ICS, JNU (Jawaharlal Nehru University), and the Ministry of Petroleum and Natural Gas. From China the participating institutes included the SASS (Shanghai Academy of Social Sciences); Institute of Euro-Asian Development, Development Research Centre, State Council of PRC; China Foundation for International Studies and Academic Exchanges; as also former diplomats. The participants in the Shanghai dialogue included ICS, TERI, JNU, and Greentech from India, and Mr Zhou Gang, former Chinese Ambassador to India, Scholars from the Shanghai Academy of Social Sciences; Shanghai Centre for International Studies, Institute of Euro-Asian Development, Development Research Centre, State Council of PRC, School for International Studies, Fudan University, and Shanghai Institute of International Studies from China. This article reports on both dialogues.

The deliberations reflected on the current trends in the international oil and gas markets, characterized by a growing demand, rising oil prices, increased resource nationalism, increased

overseas oil and gas equity initiatives, the emergence of new oil ties, and concerns with safety of transit routes. With the growing global presence of India and China, not only is one witnessing structural changes in the market and the entry of new agents, but also a change in the nature of the discourse around energy-securing strategies. This discourse is now much more couched in the language of competition and potential conflict. Moreover, continuous political instability and unexpected events in a majority of the energy-producing countries have created a growing concern about the availability and affordability of oil. This debate on the consumer side juxtaposed with the growing instability among several of the major oil-producing countries, and concerns with delivery to market, has brought back to centre-stage, the linkages between resources and global security issues.

The discussions suggested that the energy situation that both India and China face are similar, with both the countries growing at a high rate and experiencing high energy intensities. The per capita commercial energy consumption is much lower than the worldwide average, with India consuming about a fifth and China about half the world average of 1552 kgoe (kilogram of oil equivalent). At the same time, there is a very high dependence on traditional energy sources, which in turn have implications on the environment and health. Both countries, which at present have a low vehicle ownership, are experiencing rapid motorization which is projected to increase further with the rising incomes and aspirations, and expected to lead to an increased demand for middle distillates.

The perceptions of risk for both countries are linked to seeing energy security issues through the hydrocarbon prism. These are linked to the prevailing high crude oil prices and expectations that this situation will last for some time, the high oil intensity and import dependency that the two countries face, the concentration of oil and gas resources and import sources in regions of the world, and environmental constraints relating to fossil fuel usage. Most of India's imported oil comes from West Asia (68%), followed by 23% from Africa; and 4% from South East Asia; and 4.5% from Central America. In China, more than 40% of the oil imports come from West Asia, 17% from Saudi Arabia, 14% from Iran. Many of the countries are faced with instability either from within or from external sources. Hence, there is a concern that external or internal factors could result in a stoppage of oil supply, holding up the country's economic growth. India and China are also more actively concerned with safety of sea-lanes, in particular the key transit routes – the Strait of Hormuz – as all of the imports through the Persian Gulf have to pass through this strait, the Strait of Malacca (75% of China's oil comes through it) and the Taiwan Strait, both of which its oil tankers use. Strategies adopted by the two countries are also influenced by each country's perception of its space in the international context, and worries over embargoes, containment, and blockades, which may affect a smooth flow of energy supplies.

In terms of managing risks, participants observed that the strategies and policies that the two countries are adopting are quite similar, although the intensities with which they are being pursued are different. *Domestically*, the two countries are looking at enhancing domestic oil and gas search, laying a greater focus on natural gas, coal, hydropower, and nuclear power; a keener interest in assessing the role that technology has to play in enhancing resource availability and in reducing energy requirements. The strategies also include developing SPR (strategic petroleum reserves) and giving greater attention to renewables. On the *external front*, the two countries are actively pursuing strategic diversification of oil supply sources, diversification of energy imports to gas and coal, trans-national pipelines, and energy collaboration and partnerships. Both countries are engaged in pursuing oil sourcing in some countries, which have been out of bounds for western companies. This has created some concern and has over the last year generated an international debate on whether this would erode the power of western countries to stabilize these regions through sanctions on trade.

Despite some instances of competition over equity oil investments, both countries do realize that increased competition will only bid up prices of properties, create a higher financial burden, and increased distrust that could lead to greater global

insecurity. It was pointed out that resource conflict between the two countries is not inevitable, as the two countries have a long-term interest in each other's security and prosperity. There is a growing recognition in the two countries on the importance of energy cooperation, and partnerships, and the fact that energy-securing strategies need not be seen in zero-sum terms. Given the size of their populations, it is in the long-term interest of both India and China to work towards global energy and environmental security, not just national and regional.

A less conflictual approach to securing energy, it was agreed, would need to be more rule-based and, less pre-emptive, requiring lifestyle changes, and changes in modes of transport. Over the last two years, a number of steps have been taken towards a greater collaboration on the energy front both as Track 1 and 2 initiatives. The two countries have signed an MoU on bilateral cooperation on hydrocarbons and four agreements between Indian and Chinese companies. Multilaterally, tripartite cooperation has been initiated between China, India, and Russia, through cross participation in regional groupings. India is an observer of the Shanghai Cooperation Organization, and China has become an observer in SAARC.

In Shanghai, the discussions centred on cooperation in the following areas:

Strengthening institutions, systems, and organizations Presenters said that there were insufficient institutions to address energy-efficiency issues in both countries especially at the sub-national level; that there was a need to revisit energy distribution networks. It was argued that decentralized distribution would not only improve energy access but also be a response to security threats. Arguments were made of the need to go beyond having just state enterprises in energy, and support private companies such as SUNTEC and Suzlon. Other suggestions were to invest in more efficient transport systems, a joint Indo–China energy research cell or institute. On a more global level, a plea was made to support the Energy Charter Treaty

On science and technologies for cleaner fuels and their uptake The need to avoid the hydrocarbon dominance in the long run was also highlighted. Both India and China have renewable energy targets, with China targeting 10% of electric power capacity by 2010 and India aiming at 10% of added electric power capacity by 2012 through the renewable energy route. The countries have also achieved moderate success in promoting renewable energy. The participants made a case for the countries working together on new technologies and taking a lead in mainstreaming renewable energy. It was felt that there was scope to work together on mechanisms for technology transfer, on intellectual property rights issues relating to carbon-saving technologies, and pushing for more rational energy prices to provide the right signals for uptake of clean technologies.

On energy efficiency in buildings and in small and medium enterprises The lowest hanging fruit seems to be to share expertise and work together on improving energy efficiency in building and SMEs (small and medium enterprises). TERI's green buildings rating systems and other building codes were discussed, as was cooperation in building materials. In case of SMEs, it was felt that a joint study could be initiated to map efficient technologies in SMEs and work on specific transfers, for example in brick kilns.

Finally, it was strongly argued that these dialogues now need to result in some concrete joint research or implementation projects.

Centre for Research on Energy Security

CeRES (Centre for Research on Energy Security) was set up on 31 May 2005. The objective of the Centre is to conduct research and provide analysis, information, and direction on issues related to energy security in India. It aims to track global energy demands, supply, prices, and technological research/breakthroughs – both in the present and for the future – and analyse their implications for global as well as India's energy security, and in relation to the energy needs of the poor. Its mission is also to engage in international, regional, and national dialogues on energy security issues, form strategic partnerships with various countries, and take initiatives that would be in India's and the region's long-term energy interest. *Energy Security Insights* is a quarterly bulletin of CeRES that seeks to establish a multistakeholder dialogue on these issues.

Previous issues of this newsletter are available at <http://www.teriin.org/div_inside.php?id=41&m=3>.

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