# Potential Impacts of a Global Cap and Share Scheme on India


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# 1 INTRODUCTION

The pilot report on the effects that Cap and Share (C&S) might have if introduced in a BRICSA country as part of a global climate settlement was prepared for South Africa by Jeremy Wakeford. This report for India follows Wakeford's model.

Conditions in India are unique, as indeed they are in every country. Some elements of the pilot study, especially the impact on trade, have been shortened, whilst the section on the impact on households is given more prominence.

The introduction of Cap and Share would mean that Indian households received a direct payment for their share of each year's global emission rights. Such payments might double the country's GDP.

## *1.1 Overview of the Cap & Share scheme*

Full details of Cap and Share may be found on the Cap and Share (www.capandshare.org) website and on the website of the Irish-based NGO which developed the concept, Feasta, (www.feasta.org) where Jeremy Wakeford's report is also found. (http://www.feasta.org/documents/energy/Cap_and_Share_South_Africa.htm )

Cap and Share was developed to meet the twin challenges of climate change and the peak in the world supply of easily-extracted oil. It works by imposing a limit - a cap - on global emissions from the use of coal, gas and oil and then charging fuel users whatever price is necessary to balance their demand with the capped supply. The bulk of the payments made by the fossil fuel users are then shared amongst the whole human population on an equal-per-capita basis. This compensates people, at least in part, for the increase in energy prices caused by the scarcity created by both the decline in oil production from its peak and the limited production of gas and coal as a result of the emissions restrictions. In this way, it shares out the benefits from using fossil fuel amongst everyone in the world.

Essentially, then, C&S is a way of capturing the scarcity rent - the extra that consumers are prepared to pay when whatever they are consuming gets scarce - and redistributing it. If C&S or some equivalent system is not introduced, the scarcity rent as a result of the restricted supply of oil will continue to go to the oil producers and to the producers of gas and coal because of the increased prices they have been able to charge as a result of oil's scarcity. Recent reports indicate that these rent payments are already leading to an extreme concentration of wealth and weakening global financial stability (see for example Llewellyn, 2006).

Under C&S, the level of emissions permitted under the cap would be reduced year by year at whatever rate the international community decided was necessary to guarantee climate stability. As Appendix A explains, this rate would need be to be at least as fast as oil production was declining if the maximum amount of scarcity rent was to be available for distribution. This is because, to capture the most rent, the emissions permits issued under the cap would have to be a scarcer resource than the oil supply. Recent estimates[2] by the International Energy Agency indicate that global oil supplies are likely to decline by between 6 and 9% a year, depending on the level of capital investment made by the producers.

It is important to recognise that, if adopted globally, C&S would only increase fossil fuel prices by an amount based on the additional scarcity it had created for climate reasons. All of the extra money that people paid for their fuel because of this climate surcharge would be returned to them in one way or another. It would not be a tax. Moreover, C&S would retrieve some of the money currently being paid to fossil fuel producers as scarcity rent and distribute it around the world. It has therefore the potential to make millions of poorer people better off.

[2] *Financial Times, London, 29 October, 2008*

C&S shares the scarcity rent by distributing most of the emissions permits issued under the cap directly to individuals, who then sell the permits, known as Pollution Authorisation Permits, or PAPs, at whatever is the current market price, to financial intermediaries such as banks and post offices. The intermediaries then consolidate the PAPs and sell them on to fossil fuel producers who would be required to buy sufficient permits each year to cover the emissions from the fuel they had produced. Inspectors would ensure that they complied.

The concept of sharing the scarcity rent on oil is not new in India where public sector and private sector oil marketing companies have shared the burden of price increases with consumers for some time, in what is known as burden sharing. The prices of essential petroleum based cooking fuels LPG and kerosene in India have remained unchanged since 2002. Diesel and petrol prices are also kept at below international prices. However, C&S differs from burden sharing because the sharing of scarcity rent would not be managed by the Government of India first, but by a new international organisation, the Global Climate Trust which would be set up by a decision of the Conference of the Parties to the Framework Convention on Climate Change.

C&S's potential for making large sums of money available directly to the people is especially important in India where the Public Distribution System (PDS) for essential commodities based on fair prices is failing, and 400 million people are in absolute poverty, depending on which criteria are applied. Many people today are advocating changing the PDS to a system of direct cash payments. Though there are some logistical issues here too, such as distance from post offices and banks, C&S seems to be a system that allows welfare support to the poor to actually reach them. It also allows the poor to choose what they buy, rather than having to put up with what others choose for them.

Since Jeremy Wakeford's report was written, the threat to global financial stability that was in part due to the excessive, but inevitable, rent-taking by oil exporting countries and private oil companies has become a reality. It is thus even more important that the world learns from India' prudent financial management and introduces a C&S scheme that makes international burden sharing in fossil fuel prices a global reality. Whether the Government of India will consider C&S attractive enough to offset the dangers of integrating more fully into the global energy economy cannot be answered in this paper. The government along with all G77& China and AOSIS countries called for a Conference of the Parties bank at the Working Group for Long term cooperative action meeting in Bonn in June 2008, (http://www.twnside.org.sg/bonn.news.htm), as indeed it did in 1991 (document A/AC.237/WGII/CRP.9 18 December 1991, at www.unfccc.int), and the C&S scheme including the Global Climate Trust may be one way of arranging the financing in an equitable manner, for a trust that, in effect, serves the purposes of such a bank. Government of India recently again repeated[3] their opposition to the continuation of the inequitable and unaccountable Bretton Woods arrangements for managing global change or anything else, and refused to participate in the World's Bank's so-called climate investment funds. Under C&S, in addition to the new, democratically managed, Global Climate Trust, the C&S scheme envisages setting up a Transition Fund. Some of each year's emissions permits are auctioned by the Global Climate Trust directly and the proceeds go into the Transition Fund to finance those commitments (assumed in this study to be financed by 15% of emissions permits) which the CoP must take care of directly.

### 1.2 Aims of the study

This study aims to assess the initial impact that the introduction of a global C&S scheme would have on Indian households and industries. The word initial needs to be emphasised because the introduction of C&S would generate a new set of relative prices. In particular, it would create a climate within which people believed that energy prices would not only remain high but get higher over the years and that they should therefore develop ways of living and working which required as little fossil energy as possible. They would also want to invest in developing non-fossil energy sources. In other words, C&S would initiate such a flood of investment and change that conditions after it has operated for a little while are impossible to predict.

*3 Times of India, Delhi, 10 Oct 2008*

Because C&S would not only enable poorer people to spend more but can also be expected to touch off a wave of energy-intensive capital investment, it could increase fossil energy demand and, consequently, energy prices. It is impossible to say how high these prices might be on its introduction. But it is important that the Global Climate Trust limits the percentage of profit to the oil companies so as to set a relatively high PAP price to redistribute to people. The study therefore suggests what would happen to Indian prices and incomes for a range of energy prices with a fixed profit to oil producers based on India's current benchmark for renewable energy companies of 16%. The rest of the oil price is captured for burden sharing by Cap and Share. The initial effects it explores are those on:

- the prices of energy products and the prices of energy-intensive goods;
- the current account of the balance of payments;
- the aggregate macroeconomy;
- household expenditure, income and inequality;
- energy-intensive industries; and
- opportunities for developing renewable energy sources.

### *1.3 Scope*
This report is limited both by current availability of data and by time. It is not intended to be a comprehensive analysis. The report covers potential impacts of C&S on the macroeconomy, households (at income deciles and by rural or urban residence) and major sectors of the economy.

### *1.4 Assumptions*
The analysis in this study is based on the following assumptions about the implementation of C&S:

- C&S is introduced globally now (end 2008). This is to allow current data to be used.
- PAPs are allocated on a per capita basis rather than a per adult basis to allow household data to be used.
- The possible prices of oil, including the Cap and Share element, range from $60 per barrel to $400 immediately after C&S's introduction. Appendix 1 converts the scarcity rents into prices per tonne of CO2 and sets out the estimates for the amount of the scarcity rent that C&S captures based on the various oil prices and various assumptions about the share of profits allowed to the producers. The CO2 prices range from zero to $780 or €500. The benchmark prices used in this study are €25, €50, €100, €200 and €400.
- The prices of coal and gas and biomass are assumed to maintain their current relationship with the oil price after allowing for the effects of the CO2 price.
- Though the price of biomass varies across regions and states of India, it is important to include this fuel as 73.4% of people in India are dependent on biomass for cooking and water and space heating. It is assumed that the price of biomass maintains its current relationship with the oil price after allowing for the effects of the CO2 price. It is assumed that 20% of total agricultural GDP at factor cost (20% of 25.6%), and the full value of forestry GDP at factor cost (1.07%) are attributable to biomass energy generation. This is necessary as 73.6% of Indian households or 141,567,437 households out of 191,963,935 use either biomass (52.5%), crop residue (10%), cow dung (9.8%), biogas, or other and or no cooking fuel (0.4%+0.6%+0.3%). This proportion is too large to ignore and the costs of this sector are thus taken into account, unlike in the South Africa study. In India biomass is not free anywhere and if it is it, is collected laboriously and signifies starvation-level wages. Once a local market experiences an injection of cash the first thing that gets commercialized is biomass energy even for household energy using old technologies. Industry also uses biomass for process heat using old technologies. The price of this 17% of total biomass shadows coal prices directly too. We are also envisaging a change in household biomass energy technology that will move people up the energy ladder in which case household energy biomass prices will continue to shadow commercial energy price rises in any case. In addition modern biomass energy technologies for domestic and industrial purposes such as decentralized biomass gasification or combustion for electricity will also create new markets for biomass at commercial prices. For all these reasons increases in the cost of biomass are taken into account in increased overall energy prices as the price of CO2 rises, and they thus also feed through into higher overall consumer retail prices.
- Prices around the world are assumed to adjust instantaneously to the new level of energy prices brought about by C&S. In actual use, of course, prices would adjust over a period of months or years and economic behaviour and production processes would change as well. This assumption consequently exaggerates the price changes that would occur.

- The global per capita CO2 emission allowance is assumed to be 3.71 tonnes per capita. This figure is based on the EIA's (2005) estimate of average global emissions of 4.37 tonnes of CO2 per person, less 15% (5% for the Transition Fund, 9% for to pay for sequestration and 1% for overheads). This includes CO2 emissions from the burning of fossil fuels only (not from land use, waste, agriculture, etc.).

### 1.5 Methodology

The study employs a mix of quantitative and qualitative analysis. Wherever suitable data permit, quantitative projections are made. No attempt is made at formal modelling as it is considered beyond the scope of this exploratory report.

### 1.6 Data

This study utilises data from a variety of international and Indian sources, including the following:

- International Energy Agency (IEA)
- US Energy Information Administration (EIA)
- Central Statistical Organisation (CSO)
- Department of Commerce and Industry (DCI)
- Ministry of Petroleum (MoP)
- Central Electricity Authority (CEA)
- Census 2001
- Ministry of Environment and Forests (MoEF)

The data are mostly taken at face value and are assumed to be sufficiently reliable, or at least the most reliable data sources that are publicly available. The most recent available (annual) data are utilised. In the case of energy and emissions, as well as household income and expenditure, the most recent publicly available data are for 2005. Energy prices are available as of October 2008.

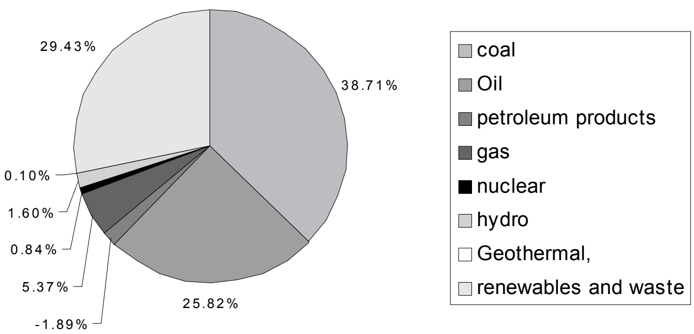
## 2 INDIAN BACKGROUND

Before exploring the impact of C&S, it is necessary to sketch the context of the Indian energy socio-economy. Section 2.1 provides an overview of energy sources and consumption. Section 2.2 details the country's CO2 emissions from energy. Section 3.3 briefly describes the current socio-economic context.

### 2.1 Energy supply and consumption

In 2005 India produced 846.3 thousand barrels of oil a day, and consumed 2653 thousand barrels. Petroleum imports constitute 31% of India's total imports; petroleum product exports account for 17.27% of total exports. It is expected that 90% of India's oil will be imported by 2030. Production and consumption of natural gas are roughly equal at around 1000 billion cubic feet per year in 2005. Imports of natural gas are expected to rise substantially in the near future. In 2005 India produced 400 million Metric tonnes of coal and imported 30 million. India has the world's fourth largest coal reserves. Coal exports are not of importance to its economy.

*FIGURE 1: Shares of total primary energy supply in India, 2005*




*Source: International Energy Agency (2008)*

*TABLE 1: Carbon dioxide emissions for selected countries, 2005*

| | CO2 emissions in 2005 | | |
|---|---|---|---|
| | t/$ 000 (PPP) | t/$ 000 (MER) | t/capita |
| USA | 0.54 | 0.54 | 20.14 |
| Canada | 0.61 | 0.77 | 19.24 |
| Australia | 0.67 | 0.90 | 20.24 |
| Europe | 0.39 | 0.47 | 7.93 |
| Russia | 0.84 | 4.85 | 11.88 |
| Brazil | 0.24 | 0.54 | 1.94 |
| China | 0.63 | 2.84 | 4.07 |
| India | 0.29 | 1.78 | 1.07 |
| Africa | 0.46 | 1.41 | 1.17 |
| World | 0.49 | 0.78 | 4.37 |
| RSA | 0.84 | 2.65 | 9.56 |

*Notes:*

- *t = metric tonnes*
- *PPP = purchasing power parity*
- *MER = market exchange rates*

*Source: Energy Information Administration (2008a)*

India's primary electricity production is mainly from coal (39%), with nuclear power (0.84%) supplying a small fraction, though this fraction is expected to rise to around 3% by 2030. Renewable energy use is currently significant (29.43% of TPES). This is mainly due to the fact that 74.3% of households use traditional biomass such as agro-residues and wood and other biomass-based energy consumed using mainly traditional technologies. These households are overwhelmingly poor and are mainly rural and peri-urban. The Government has a National Action Plan on Climate Change, and a Ministry for Non-Convention Energy, and a large Public Distribution System for fair-price food and energy. The Government of India's main concern is lack of movement by developed countries in accelerated technology sharing for equitable development and climate change mitigation.

## 2.2 CO2 emissions

Despite its heavy reliance on coal, India is one of the lowest emitters of CO2 (from energy consumption) on a per capita basis (see Table 1). In 2005, per capita CO2 emissions (1.07 tonnes per capita) were less than a quarter the global average (4.37) and were lower than those of the EU, China, India, South Africa and Brazil. India however ranks highly in terms of projected CO2 emissions growth. The Government of India has committed that India's per capita emissions will not rise above the global average.

Figure 2 shows that India's CO2 emissions from the burning of fossil fuels have grown four times over the past two and a half decades.

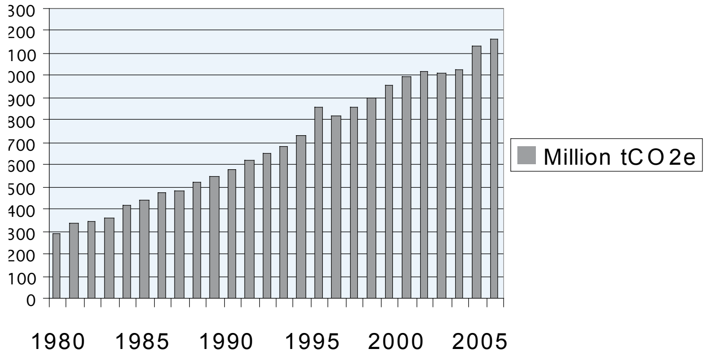
## 2.3 Socio-economic context

India stands to benefit from the C&S scheme for nine out of ten income deciles. The income from the proceeds of sale of PAPs could be between 9.08% and 145.26% of current GDP.

India is set to become the most populous country on earth by 2030, and 42% are below the poverty line, and only 13.7% can be counted as comfortable. The degree of income inequality is amongst the highest in the world. There are deep inequalities in access to and consumption of energy across households in India, mirroring the extensive income and wealth inequality. India's state power utilities the State Electricity Boards produce and market amongst the cheapest electricity in the world, but only 90.4 kWh of electricity were available per person in 2006. Private motor vehicle ownership is growing, while buses, the railway, and three-wheeler and four-wheeler taxis are the dominant mode of transport. Air travel has gone up from 107 million passengers to 626 million since 1980. The Government provides the aviation industry with some protection against international oil price rises.

Aside from poverty and unemployment, one of the significant economic challenges for India is how to increase provision of affordable and sustainable energy sources to the people. Domestic firms have long benefited from amongst the lowest electricity tariffs in the world, but as carbon emissions reductions become more important nationally, a system such as C&S may make it attractive for India to become more linked to a new sustainable global economy. In this case industry may be willing to adapt to higher energy prices as they can pass on the price rise to the people who will have more than enough income from the proceeds of sale of their PAPs to bear the price increase.

*FIGURE 2: Carbon dioxide emissions from fossil fuel consumption in India*




*Source: Energy Information Administration (2008a)*

*TABLE 2: CO2 emission factors for various energy carriers*

| Energy Carrier | CO2 emission (kg) | Unit of energy |
|---|---|---|
| Coal | 2.46 | kg |
| Petrol | 2.34 | litre |
| Diesel | 2.68 | litre |
| Kerosene | 2.63 | litre |
| LPG | 1.53 | litre |
| Electricity | 0.80 | kWh |

*Source: EIA (2008b), CEA (2008) and own calculations.*

## 3 IMPACT ON PRICES

Restrictions on the use of fossil fuels will raise their price and the price of electricity. These direct price effects are explored in section 3.1, while the resulting impact on the consumer price index is dealt with in section 3.2. CO2 restrictions will also feed through into higher prices of many other goods and services since electricity and transport fuels are input costs for many economic activities and products. These indirect price effects are addressed in section 3.3. Section 3.4 considers the sensitivity of the computed price effects to the assumptions, and notes that the effects would occur within a context in which energy prices have been rising steeply for several years already.

### 3.1 Energy prices

Before calculating the effect of C&S on energy prices, one needs estimates of the CO2 emission factors for the various energy carriers. Table 2 gives estimates of the mass (in kilograms) of CO2 emissions per unit of energy for the main energy carriers used in India. Electricity has a relatively high CO2 emission factor per kilowatt hour due to the fact that most of the country's electricity is generated from low-grade coal.

Table 3 displays prices for the main retail energy products in India as of February 2008. The retail prices of petrol, Kerosene for cooking (SKO), Kerosene for aviation, LPG for cooking, LPG for transportation, and diesel, are regulated by the Ministry of Petroleum. Coal is used by only 2% of households for cooking, and not at all for other uses. The price of coal is regulated by Coal India Ltd., but there is no standard average national retail price of coal for households. Coal is mainly consumed by electricity generating companies

*TABLE 3: Energy price increases at various CO2 prices per tonne*

| CO2 price | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| | | Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| | | Rs/kg | 1.5 | 3 | 6 | 12 | 24 |
| **Energy carrier** | **Initial price** | **Unit** | **Price increase due to restrictions in Rs** | | | | |
| Coal | 1.54 | Rs/kg | 3.69 | 7.38 | 14.76 | 29.52 | 59.04 |
| Petrol | 43.52 | Rs/litre | 3.51 | 7.02 | 14.04 | 28.08 | 56.16 |
| Diesel | 48.00 | Rs/litre | 4.02 | 8.04 | 16.08 | 32.16 | 64.32 |
| Kerosene | 45.00 | Rs/litre | 3.95 | 7.89 | 15.78 | 31.56 | 63.12 |
| LPG | 24.14 | Rs/kg | 2.30 | 4.59 | 9.18 | 18.36 | 36.72 |
| Electricity | 4.74 | Rs/kWh | 1.20 | 2.40 | 4.80 | 9.60 | 19.20 |
| Biomass | 2.00 | Rs/kg | 3.69 | 7.38 | 14.76 | 29.52 | 59.04 |
| **Energy carrier** | | | **Price increase as factor** | | | | |
| Coal | | | 2.40 | 4.80 | 9.60 | 19.19 | 38.39 |
| Petrol | | | 0.08 | 0.16 | 0.32 | 0.65 | 1.29 |
| Diesel | | | 0.08 | 0.17 | 0.34 | 0.67 | 1.34 |
| Kerosene | | | 0.09 | 0.18 | 0.35 | 0.70 | 1.40 |
| LPG | | | 0.10 | 0.19 | 0.38 | 0.76 | 1.52 |
| Electricity | | | 0.25 | 0.51 | 1.01 | 2.02 | 4.05 |
| Biomass | | | 1.85 | 3.69 | 7.38 | 14.76 | 29.52 |

*Notes:*

- *The Rs/euro exchange rate is assumed to be 60.0.*
- *The price of coal is an estimate from Coal India Ltd (2008).*
- *The prices of petrol and diesel are as mentioned in Deora, (2008).*
- *The price of Kerosene is the open market or black market price.*
- *The price of LPG is the average price to households.*
- *The price of electricity is an approximate 2008 national average price (4.74 Rs/kWh). Households would typically pay lower electricity tariffs than industrial users though this differs from state to state.*

*Source: Deora (2008), Coal India Ltd. (2008), and own calculations.*

and various industries, such as steel making, typically under long-term supply contracts. There are 83 coal fired power station complexes, and 63 gas, oil, diesel and naphtha fired plants. They purchase their coal under long-term contracts for approximately Rs 800-2000 per tonne, with the remainder being procured on the spot market for higher prices. The average chosen is the average for grades A to D coal, and is 1539 Rs per tonne (Coal India Ltd., 2008). The price of coal cited is also used for the estimate for households, since this is relevant for the calculations in section 5 on household expenditures.

Unless figures and tables explicitly show numbers as percentages, the tables in this report show changes in prices as factors. Thus for example a percentage increase of 240% is shown as a change of 2.4. A percentage decrease of  8% is shown as a change of -0.08.

Table 3 also displays the absolute and percentage price increases that would arise if the restrictions on fossil energy use produced a CO2 permit price at various levels. It can be seen that the proportional impact on the prices of liquid fuels is small for the lowest level of the CO2 price (€25), although the prices double if the price is at the highest level (€400). The price of coal rises markedly – by more than double at the lowest CO2 price level. The price of electricity rises by a quarter at the lowest carbon emissions price, and increases four-fold at the highest rise considered in this study. This reflects the fact that 68% of electricity is generated in coal-fired power stations. The worst hit are biomass users and industrial users of coal. The price of biomass rises thirty times and the price of coal nearly forty times.

## 3.2 Direct impact on final private consumption expenditure

Table 4 shows the effect on Final Private Consumption Expenditure of the rise in energy prices according to the various levels of the CO2 price. The rise in transport fuel (petrol and diesel) prices has a modest impact on FPCE while the rise in household energy prices – driven mainly by electricity – has a dramatic impact on the overall FPCE when the CO2 price is high. Taken together, the higher energy prices raise the FPCE by between 11.2% and 178.9% depending on the CO2 price level.

*TABLE 4: Direct impact on Final Private Consumption Expenditure of higher energy prices*

| CO2 price | | | | | |
|---|---|---|---|---|---|
| Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| **Percentage price increase** | | | | | |
| Transport fuel | 0.08 | 0.16 | 0.33 | 0.66 | 1.32 |
| Household energy | 1.43 | 2.86 | 5.72 | 11.43 | 22.86 |
| **Resultant percentage change in FPCE** | | | | | |
| Transport fuel | 0.01 | 0.02 | 0.04 | 0.08 | 0.17 |
| Household energy | 0.10 | 0.20 | 0.41 | 0.81 | 1.62 |
| Total | 0.11 | 0.22 | 0.45 | 0.89 | 1.79 |

*Notes:*

- *Transport fuel has a weight of 7.56% in the estimates of Final Private Consumption Expenditure. Central Statistical Organisation (2006). The price increase is the average across petrol and diesel.*
- *Household energy (fuel and power) has a weight of 7.1% in the in the estimates of Final Private Consumption Expenditure. Central Statistical Organisation (2006). The relative weightings of the energy sub-components (electricity, coal, LPG, Kerosene and Biomass) are drawn from Census( 2001).*

*Source: Central Statistical Organisation (2006), Census (2001) and own calculations*

## 3.3 Indirect price effects

As mentioned earlier, increases in the prices of basic energy carriers (liquid fuels and electricity) will feed through into higher prices of other goods and services in the economy.  Estimating these indirect price effects on food which accounts for 51.33% of consumption expenditure  would be a very complex task requiring econometric models, and is beyond the scope of this report. However, a rough approximation of the indirect impact on prices can be made at a macro level. Central Statistical Organisation (2006) provides the weightings of "electricity, gas and water supply" (2.5%), "transport, storage and communication" (7.35%) and "agriculture, forestry and fishing" (25.33%) in the estimates of GDP at factor cost by kind of economic activity, 1999-2000. These three sectors determine the proportion of energy costs in total costs for goods and services in the domestic economy. It may be considered that 90% of forestry (1% of GDP at factor costs), and 20% of agricultural production (which makes up 23.56% of total GDP at factor costs) goes towards energy. Thus 5.7% is taken as the proportion of GDP at factor cost dedicated to biomass energy generation. The weights are used to approximate the impact of rising energy prices on the prices of non-energy goods and services following the introduction of C&S. The results are shown in Table 5.

The foregoing producer price effects can be used to estimate the impact of rising energy input costs on retail (consumer) prices. The percentage rise of retail prices is the same as for factor prices.[4]

The final step in estimating the indirect price effect of rising energy prices is to approximate the impact of higher transport fuel costs on retail prices of consumer goods and services. The final row of Table 5 contains estimates of the combined indirect effect of higher energy prices on consumer prices, i.e. those attributable to energy inputs plus the impact of higher transport costs on production. Due to lack of data it is assumed that for every Rupee rise in transport costs the production costs rise by 0.03 Rupees. It can be seen that carbon restrictions lead to a 21% rise in private final consumption expenditure at the lowest CO2 prices but more than two and a half-fold increase at the highest CO2 price level.

*TABLE 5: Indirect effect of higher energy prices on consumer prices*

| | CO2 price | | | | |
|---|---|---|---|---|---|
| Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| | **energy price increase as factor** | | | | |
| Electricity | 0.25 | 0.51 | 1.01 | 2.02 | 4.05 |
| Petroleum | 0.09 | 0.17 | 0.35 | 0.69 | 1.39 |
| Coal | 2.40 | 4.80 | 9.60 | 19.19 | 38.39 |
| Biomass | 1.85 | 3.69 | 7.38 | 14.76 | 29.52 |
| | **Impact on costs** | | | | |
| Electricity | 0.01 | 0.01 | 0.03 | 0.05 | 0.10 |
| Petroleum | 0.01 | 0.01 | 0.03 | 0.05 | 0.10 |
| Coal | 0.06 | 0.11 | 0.22 | 0.45 | 0.89 |
| Biomass | 0.11 | 0.21 | 0.42 | 0.84 | 1.68 |
| **Total** | **0.17** | **0.35** | **0.69** | **1.39** | **2.78** |
| | **Impact on retail prices** | | | | |
| Electricity | 0.01 | 0.01 | 0.03 | 0.05 | 0.10 |
| Petroleum | 0.01 | 0.01 | 0.03 | 0.05 | 0.10 |
| Coal | 0.06 | 0.11 | 0.22 | 0.45 | 0.89 |
| Biomass | 0.11 | 0.21 | 0.42 | 0.84 | 1.68 |
| Total | 0.17 | 0.35 | 0.69 | 1.39 | 2.78 |
| | **Total indirect impact on consumer prices** | | | | |
| **Total** | **0.18** | **0.36** | **0.71** | **1.43** | **2.86** |

*Notes:*
- *Electricity has a weight of 2.5% in the estimates of GDP at factor cost.*
- *Transport and communication (petroleum) has a weight of 7.35% in the estimates of GDP at factor cost.*
- *Biomass has a weight 20% of agricultural production, plus 90% of forestry production i.e. 20% of 23.56% plus 90% of 1.02%*

*Source: Own calculations based on Central Statistical Organisation (2006).*

### 3.4 *Sensitivity of price effects to initial prices and assumptions*

The percentage increases in energy prices calculated above are sensitive to the starting prices, some of which have been volatile in recent months.

Firstly, petrol and diesel in India have been rising over the past year, driven by the price of crude oil, which has risen from about $20 per barrel in 2002 to around $130 per barrel in mid-2008, as well as by a weakening exchange rate. These price increases were not passed on fully to consumers, as burden sharing by the oil marketing companies to the extent of around 15 billion Euros in 2007-2008 protected consumers from too steep price rises. Altered patterns of demand due to C&S will be seen mainly in increased attention to, and money for, biomass energy supply, which is a underfinanced sector in the economy today, with GDP from agriculture rising by only 0.7% in 2007 compared to overall growth of 11%.

Secondly, electricity prices are set to increase markedly over the next few years. State Electricity Boards continuously experience problems meeting peak electricity demand. India needs another 100'000 MW of coal, and say 10'000 MW of renewables capacity as per current projections, but the balance may change depending on the allocation of C&S income and also changes in priorities by the electricity sector due to the impact of rising cost of PAPs.

Thus, in the future, rising fuel prices might be primarily determined by C&S (depending on how fast the emissions cap and therefore consumption is reduced year-to-year).

The results in the preceding subsections are also somewhat sensitive to the other assumptions. For instance, the Rs/euro exchange rate has also been somewhat volatile in recent months, and the Rs/USD exchange rate has been especially volatile. However the fact that a range of Euro-denominated CO2 prices is used means that the quantitative estimates give a range of possible outcomes; they should not be interpreted as precise point estimates. Nonetheless, it is important to bear the sensitivities in mind as they carry through into the estimated impact of price changes on household expenditures (see section 5).

## 4 IMPACT ON THE MACROECONOMY

It is useful to begin the analysis at the macroeconomic level. Section 4.1 examines the potential impact of C&S on the balance of trade. Section 4.2 compares the overall national cost of CO2 emissions from fossil energy use with the total income that would accrue to India from its share of world PAPs. Overall India would earn more from sale of PAPs than it would spend on increased energy prices. Due to restrictions on oil, coal and gas production around the world, trade overall is bound to decline.

### 4.1 Balance of payments

C&S would have an impact on India's exports and imports to the extent that traded goods embody fossil energy and therefore carbon dioxide. Fossil fuels are embodied in traded goods at two stages: (1) when fossil energy sources are used in the production process; and (2) when the goods are transported (since transport is overwhelmingly reliant on oil and to a small extent gas and coal). Export companies that produce fossil fuels will have to purchase permits to cover their emissions, and will as far as they are able to pass on the extra costs to their customers. The same will apply to firms in other countries that export to India. In addition, the prices of traded goods will rise as a result of the higher transport costs (since these will also have a CO2 cost component).

Table 6 displays India's exports, imports and trade balance in 2005 disaggregated into the main sectors (viz. agriculture, mining, manufacturing and other). Agriculture comprises a very small of imports. Petroleum product imports contribute -21.28% to the trade deficit. Manufacturing dominates exports. Gold, diamonds and other precious items are the other main contributor to the trade deficit (in "other").

*TABLE 6: India's trade by sector in 2005*

| | Exports | Imports | Trade balance |
|---|---|---|---|
| | USD million | | |
| Agriculture | 6,851 | 2,553 | 4,297 |
| Ores and Minerals | 3,020 | 2,205 | 815 |
| Manufacturing | 49,650 | 15,321 | 34,329 |
| Petroleum | 13,186 | 38,998 | -25,812 |
| Other | 957.645 | 56,988 | -56,031 |
| **Total** | **73,665** | **116,066** | **-42,401** |
| | Per cent share | | |
| Agriculture | 9.30% | 2.20% | 3.54% |
| Ores and Minerals (E), Precious minerals (I) | 4.10% | 1.90% | 0.67% |
| Manufacturing | 67.40% | 13.20% | 28.30% |
| Petroleum | 17.90% | 33.60% | -21.28% |
| Other | 1.30% | 49.10% | -46.20% |
| **Total** | **100.00%** | **100.00%** | **-34.96%** |

*Source: Department of Commerce and Industry (2008).*

[4] *Many thanks to Richard Douthwaite for this clarification.*

In India's case, the negative overall trade balance does also result in the embodied energy (and CO2) content of imports being larger than that of exports. This is mainly because of the high percentage of crude oil imports. Imports of crude oil constitute 33.6% of total import bill in 2005. In 2005 India's net imports of crude oil amounted to 2653 thousand barrels of oil a day, or nearly 76% of total domestic consumption (IEA, 2008).

*TABLE 7: Balance of emissions embodied in trade (BEET) for select countries*

| Annex B | | | Non-Annex B | | |
|---|---|---|---|---|---|
| | **BEET MtCO2** | **BEET as a % of production-based emissions** | | **BEET MtCO2** | **BEET as a % of production-based emissions** |
| **Switzerland** | -63.1 | -122.9% | Singapore | -62.8 | -128.2% |
| **Latvia** | -4.6 | -60.7% | South Korea | -45.4 | -11.4% |
| **United Kingdom** | -102.7 | -16.6% | Morocco | -2.5 | -6.3% |
| **Germany** | -139.9 | -15.7% | Mexico | -17.6 | -4.5% |
| **Japan** | -197.0 | -15.3% | Brazil | 2.5 | 0.8% |
| **United States** | -438.9 | -7.3% | India | 70.9 | 6.9% |
| **Canada** | 15.5 | 2.8% | China | 585.5 | 17.8% |
| **Australia** | 57.9 | 16.5% | Indonesia | 58.1 | 19.0% |
| **Russia** | 324.8 | 21.6% | South Africa | 123.5 | 38.2% |

*Source: Peters & Hertwich (forthcoming) in Kejun, Cosbey & Murphey (2008).*

Table 7 contains estimates of the balance of emissions embodied in trade (BEET) for a selection of countries, which are grouped according to those which are obligated to reduce emissions under the Kyoto Protocol (Annex B countries) and those that are not (non-Annex B countries). BEET measures the CO2 emissions embodied in exports minus those embodied in imports. As can be seen, India has a positive BEET, meaning that the carbon content of its exports exceeds that of its imports.

This report is concerned with the immediate impact of C&S, which would be to raise the prices of both imports and exports by the cost of the emissions involved in their production. Using the BEET figure of 70.9 million tonnes of CO2, and assuming that prices of net exports changed in direct proportion to the cost of embodied CO2 and that the quantities of trade flows remain constant, the instantaneous impact on the trade balance can be estimated (see Table 8). The impact is significant as a proportion of GDP even at the lower levels of the CO2 price. Due to India's large population, Indian firms in the fossil fuel-intensive sector (including petroleum product exporting companies) would not have to purchase emissions rights from other countries. The cost of the permits bought at home would be offset by the higher export revenues.

Over time the patterns of exports and imports will change as the economic incentives for trading are altered by the carbon cost component. While the precise second-round impacts are impossible to determine, it is reasonable to expect some general trends. First, the demand for India's oil exports should decline (since C&S is designed to reduce fossil fuel consumption). Second, the demand for petroleum imports will also likely decline, other things being equal. Third, production is likely to become more local as transport costs rise.

## 4.2 Aggregate expenditure on CO2 and PAP income

contains estimates of the total cost of India's CO2 emissions from domestic consumption of fossil fuels under various assumptions about the price per tonne of CO2. Even at the lowest price for CO2 (€25), the total cost to the country from buying PAPs represents 12.68% of Gross Domestic Product (GDP). At the highest level of the levy (€400) twice the entire GDP.

The macroeconomic impact of C&S needs to be adjusted to reflect the balance of emissions embodied in trade. As seen in Table 9 the trade-adjusted costs of CO2 permits ranges from about 12.31% to 197% of GDP. The costs of purchasing CO2 emissions permits must however be offset against the aggregate income received from PAPs. India's population in 2005 stood at 1 billion, which results in a total CO2 allowance of 3.71 billion tonnes. This yields gross income as shown in the table.

*TABLE 8: Impact of C&S on India's trade balance*

| | CO2 price | | | | |
|---|---|---|---|---|---|
| Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| | Change in trade balance | | | | |
| Rs million | 106,350 | 212,700 | 425,400 | 850,800 | 1,701,600 |
| % of GDP | 0.37% | 0.75% | 1.50% | 2.99% | 5.98% |

*Source: Peters & Hertwich (forthcoming) in Kejun, Cosbey & Murphey (2008) and Central Statistical Organisation 2006*

*TABLE 9: Projected total cost of CO2 emissions and PAP income based on 2005 data*

| | CO2 price | | | | |
|---|---|---|---|---|---|
| Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| | Gross cost of CO2 emissions (Rs millions) | | | | |
| Coal | 1,586,700 | 3,173,400 | 6,346,800 | 12,693,600 | 25,387,200 |
| Oil | 1,790,775 | 3,581,550 | 7,163,100 | 14,326,200 | 28,652,400 |
| Gas | 229,500 | 459,000 | 918,000 | 1,836,000 | 3,672,000 |
| **Total** | **3,606,975** | **7,213,950** | **14,427,900** | **28,855,800** | **57,711,600** |
| % of GDP | 12.68% | 25.37% | 50.73% | 101.47% | 202.93% |
| | Cost of CO2 emissions net of BEET | | | | |
| Rs million | 3,500,625 | 7,001,250 | 14,002,500 | 28,005,000 | 56,010,000 |
| % of GDP | 12.31% | 24.62% | 49.24% | 98.47% | 196.95% |
| | Gross income from CO2 allowance | | | | |
| Rs million | 6,082,545 | 12,165,090 | 24,330,180 | 48,660,360 | 97,320,720 |
| % of GDP | 21.4% | 42.8% | 85.6% | 171.1% | 342.2% |
| | Net income from CO2 trading | | | | |
| Rs million | 2,581,920 | 5,163,840 | 10,327,680 | 20,655,360 | 41,310,720 |
| % of GDP | 9.08% | 18.16% | 36.32% | 72.63% | 145.26% |

*Notes:*
- *Rs/Euro exchange rate assumed to be 60.0.*
- *Population = 1.093 billion*
- *CO2 allowance = 3.71 tonnes per capita (4.37 less 15%).*
- *Total CO2 allowance = 4055.03 million tonnes.*
- *BEET = 6.9%*
- *Emission, population and GDP figures are for 2005.*

*Source: EIA (2008), National Accounts Statistics (2006).*

The final section of Table 9 displays the net income (gross income minus total costs adjusted for the BEET), which ranges from 9.08% to 145.26% of GDP. The positive net income from trading CO2 permits reflects the fact that India's per capita emissions are significantly below the world average. Thus at a macroeconomic level, India is advantaged by its low energy (carbon) intensity.

## 5 IMPACT ON HOUSEHOLDS

Households will be affected in two primary ways by C&S. First, their expenditures on energy products and their derivatives (including food and other goods and services with an energy content) will rise as the price of fossil fuels rise. Second, their incomes will be boosted by their per capita tradable CO2 allowances (PAPs). Thus each household will have a net impact, depending on their initial levels and patterns of income and expenditure. Clearly one can expect there to be winners and losers from C&S. The following subsections estimate the impact of C&S on household expenditures, incomes and net income, respectively. A number of simplifying assumptions have to be made in order to do this tractably, as noted in the text.

### 5.1 Household expenditure

Table 10 displays the average annual expenditure of households on energy, transport and food in 2005/6, in total and disaggregated by income decile and by geographical area (rural/urban settlement). As disaggregated statistics are not available for these income deciles separately, the % of expenditure on various items is left constant. Food captures the largest share. The percentage of total expenditure on both food and energy generally declines as income level rises, but as statistics are not available this is also left constant. Though higher income level groups can be expected to spend more on transport, figures are not available, and so the percentage is left the same for all income deciles for transport too. The percentage of household expenditure on energy is generally very high for the poorest, and for rural households, but declines for wealthier and urban households. It should be noted that in India Rs 21.6 per day (Rs 7884 per annum) in urban areas and Rs 14.3 per day (Rs 5220 per annum) in rural areas (at 2005 prices) defines who is poor. For 2005, 42 per cent of Indians are below the poverty line. The average income in India for 2006 was 23'222 Rs per annum (National Accounts Statistics 2006).

*TABLE 10: Average annual household expenditure in 2005*

| Income | Energy | | Transport | | Food | | Total |
|---|---|---|---|---|---|---|---|
| **Group** | Rs | % | Rs | % | Rs | % | Rs |
| **Decile 1** | 371 | 7.10% | 656 | 12.56% | 2,678 | 51.30% | 5220 |
| **Decile 2** | 560 | 7.10% | 990 | 12.56% | 4,044 | 51.30% | 7884 |
| **Decile 3** | 568 | 7.10% | 1005 | 12.56% | 4,104 | 51.30% | 8,000 |
| **Decile 4** | 639 | 7.10% | 1130 | 12.56% | 4,617 | 51.30% | 9,000 |
| **Decile 5** | 710 | 7.10% | 1256 | 12.56% | 5,130 | 51.30% | 10,000 |
| **Decile 6** | 781 | 7.10% | 1382 | 12.56% | 5,643 | 51.30% | 11,000 |
| **Decile 7** | 852 | 7.10% | 1507 | 12.56% | 6,156 | 51.30% | 12,000 |
| **Decile 8** | 924 | 7.10% | 1635 | 12.56% | 6,679 | 51.30% | 13,020 |
| **Decile 9** | 2563 | 7.10% | 4534 | 12.56% | 18,519 | 51.30% | 36,100 |
| **Decile 10** | 8520 | 7.10% | 15072 | 12.56% | 61,560 | 51.30% | 120,000 |
| **Total** | **1,649** | **7.10%** | **2,917** | **12.56%** | **11,913** | **51.30%** | **23,222** |

***Notes:***
- *Energy includes biomass, Kerosene, LPG and electricity used in homes.*
- *Transport includes operation costs (including fuel) plus transport services.*
- *Food includes foodstuffs plus non-alcoholic beverages.*

*Source: National Accounts Statistics (2006)*

Estimating the impact on total household expenditure of CO2 prices under C&S would be very complicated if attempted in a comprehensive manner. It would require estimates of price elasticities of demand for the entire range of goods and services consumed. Both income and substitution effects would come into play as consumers adjusted their expenditure in response to rising prices of fuels and electricity, as well as the indirect price increases mentioned in section 3.3 (which are themselves very difficult to estimate). For tractability, only the instantaneous effects are estimated; it is therefore assumed that households consume the same amounts of all goods and services (including energy) after the CO2 price increase. The estimated expenditure changes are therefore a function only of price changes.

### 5.1.1 Direct change in expenditure

Table 11 shows the average annual household expenditures on different energy sources (including household fuels, electricity and transport fuels) in 2005 for the income deciles. The final column gives expenditure on energy as a percentage of total household expenditure. 74.3% of households in India use various forms of biomass for cooking. 17.9% use LPG (Gas) and 7.4% use Kerosene (Liquids) and 0.2% use electricity, (Census, 2001). Only the upper centile use electricity for lighting and other applications.

*TABLE 11: Household expenditure on energy in 2005/6*

| Income Group | Household energy | | | | Transport Fuels | Energy Total | Grand Total | % of Total |
|---|---|---|---|---|---|---|---|---|
| | Electricity | Gas | Liquids | Biomass | | | | |
| **Decile 1 - Rural poor** | 0 | 0 | 0 | 371 | 656 | 1026 | 5220 | 19.66% |
| **Decile 2 - Urban poor** | 0 | 0 | 0 | 560 | 990 | 1550 | 7884 | 19.66% |
| **Decile 3** | 0 | 0 | 0 | 568 | 1005 | 1573 | 8,000 | 19.66% |
| **Decile 4** | 0 | 0 | 0 | 639 | 1130 | 1769 | 9,000 | 19.66% |
| **Decile 5** | 0 | 0 | 0 | 710 | 1256 | 1966 | 10,000 | 19.66% |
| **Decile 6** | 0 | 0 | 0 | 781 | 1382 | 2163 | 11,000 | 19.66% |
| **Decile 7** | 0 | 0 | 852 | 0 | 1507 | 2359 | 12,000 | 19.66% |
| **Decile 8** | 0 | 924 | 0 | 0 | 1635 | 2559 | 13,020 | 19.66% |
| **Decile 9** | 0 | 2563 | 0 | 0 | 4534 | 7097 | 36,100 | 19.66% |
| **Decile 10** | 5,000 | 3,520 | 0 | 0 | 15072 | 23592 | 120,000 | 19.66% |
| **Total** | **500** | **701** | **85** | **363** | **2,917** | **4,565** | **23,222** | **19.66%** |

*Source: Own calculations based on Census (2001), and National Accounts Statistics (2006)*

Table 12 shows the household expenditure on energy after a CO2 price of Rs 1500 (€25) per tonne is introduced.[5] It is assumed that biomass prices shadow coal prices. It also gives the change in energy expenditures as % of original expenditure and as a percentage of total household expenditure. Additional expenditures on energy are driven mainly by the sharply rising price of biomass. The impact is lowest on the top two income deciles (i.e. the wealthiest households) in percentage terms because Petroleum fuels price rises are much less steep than the price rise for coal and hence, for biomass.

*TABLE 12: Change in household expenditure due to CO2 price of Rs 1500/tonne*

| Income | Household energy | | | | Transport Fuels | Energy Total | Change in Total | Change as % of total |
|---|---|---|---|---|---|---|---|---|
| Group | Electricity | Gas | Liquids | Biomass | | | | |
| Decile 1 | 0 | 0 | 0 | 684 | 56 | 740 | 72.11% | 14.18% |
| Decile 2 | 0 | 0 | 0 | 1033 | 85 | 1118 | 72.11% | 14.18% |
| Decile 3 | 0 | 0 | 0 | 1048 | 86 | 1134 | 72.11% | 14.18% |
| Decile 4 | 0 | 0 | 0 | 1179 | 97 | 1276 | 72.11% | 14.18% |
| Decile 5 | 0 | 0 | 0 | 1310 | 108 | 1418 | 72.11% | 14.18% |
| Decile 6 | 0 | 0 | 0 | 1441 | 118 | 1559 | 72.11% | 14.18% |
| Decile 7 | 0 | 0 | 75 | 0 | 129 | 204 | 8.64% | 1.70% |
| Decile 8 | 0 | 88 | 0 | 0 | 140 | 228 | 8.91% | 1.75% |
| Decile 9 | 0 | 244 | 0 | 0 | 389 | 632 | 8.91% | 1.75% |
| Decile 10 | 1266 | 335 | 0 | 0 | 1292 | 2892 | 12.26% | 2.41% |
| Total | 127 | 67 | 7 | 669 | 250 | 1,120 | 47% | 9% |

*Source: Own calculations based on Census (2001) and National Accounts Statistics (2006).*

[5] Biomass includes mainly wood and other biomass including biogas. Census (2001). Liquid is Kerosene and Gas is LPG.

Table 13 provides estimates of the direct impact of rising energy prices on household expenditure in absolute and percentage change terms for the various CO2 prices. The underlying assumption, once again, is that the quantities of energy consumed do not change as the price changes. Also, as no clear statistics are available we use the National Accounts Statistics that give just a single percentage for expenditure on energy for all income groups.

*TABLE 13: Direct change in total expenditure due to higher energy prices*

| Price of CO2 | | | | | |
|---|---|---|---|---|---|
| Euro/t | 25 | 50 | 100 | 200 | 400 |
| Rs/t | 1500 | 3000 | 6000 | 12000 | 24000 |
| **Additional expenditure on energy** | | | | | |
| Decile 1 | 740 | 1480 | 2,960 | 5,919 | 11,839 |
| Decile 2 | 1118 | 2235 | 4,471 | 8,941 | 17,882 |
| Decile 3 | 1134 | 2268 | 4,536 | 9,073 | 18,145 |
| Decile 4 | 1276 | 2552 | 5,103 | 10,207 | 20,413 |
| Decile 5 | 1418 | 2835 | 5,670 | 11,341 | 22,682 |
| Decile 6 | 1559 | 3119 | 6,237 | 12,475 | 24,950 |
| Decile 7 | 204 | 408 | 815 | 1,631 | 3,262 |
| Decile 8 | 228 | 456 | 912 | 1,824 | 3,648 |
| Decile 9 | 632 | 1265 | 2,529 | 5,058 | 10,117 |
| Decile 10 | 2892 | 5784 | 11,568 | 23,137 | 46,273 |
| **Total** | **1120** | **2240** | **4,480** | **8,961** | **17,921** |
| **As % of total annual Household income** | | | | | |
| Decile 1 | 14% | 28% | 57% | 113% | 227% |
| Decile 2 | 14% | 28% | 57% | 113% | 227% |
| Decile 3 | 14% | 28% | 57% | 113% | 227% |
| Decile 4 | 14% | 28% | 57% | 113% | 227% |
| Decile 5 | 14% | 28% | 57% | 113% | 227% |
| Decile 6 | 14% | 28% | 57% | 113% | 227% |
| Decile 7 | 2% | 3% | 7% | 14% | 27% |
| Decile 8 | 2% | 4% | 7% | 14% | 28% |
| Decile 9 | 2% | 4% | 7% | 14% | 28% |
| Decile 10 | 2% | 5% | 10% | 19% | 39% |
| **Total** | **9%** | **19%** | **37%** | **74%** | **148%** |

*Source: Own calculations based on National Accounts Statistics (2006).*

### 5.1.2 Indirect change in expenditure

As described in section 3.3, rising energy prices also push up the costs of producing goods and services to the extent that production utilises energy inputs. In addition, rising diesel and petrol prices lead to higher costs of transportation and consequently to higher retail prices. Households will thus face higher prices and expenditures as a result of these indirect price effects in addition to the direct impact of higher expenditures on energy products. Based on these indirect price effects estimated in section 3.3, Table 14 shows the indirect increase in expenditure by households as the prices of non-energy goods and services (G&S) rise following the introduction of C&S.

*TABLE 14: Indirect increase in annual expenditure due to higher energy prices*

| Price of CO2 | | | | | |
|---|---|---|---|---|---|
| Euro/t | 25 | 50 | 100 | 200 | 400 |
| Rs/t | 1500 | 3000 | 6000 | 12000 | 24000 |
| | increase in retail prices | | | | |
| | 0.18 | 0.36 | 0.71 | 1.43 | 2.86 |
| | Additional expenditure on non-energy Goods and Services in Rs | | | | |
| Decile 1 | 749 | 1498 | 2997 | 5994 | 11988 |
| Decile 2 | 1132 | 2263 | 4527 | 9054 | 18107 |
| Decile 3 | 1148 | 2453 | 4907 | 9814 | 19628 |
| Decile 4 | 1292 | 2584 | 5168 | 10335 | 20670 |
| Decile 5 | 1435 | 2871 | 5742 | 11483 | 22967 |
| Decile 6 | 1579 | 3158 | 6316 | 12632 | 25264 |
| Decile 7 | 1723 | 3445 | 6890 | 13780 | 27560 |
| Decile 8 | 1869 | 3738 | 7476 | 14952 | 29904 |
| Decile 9 | 5182 | 10364 | 20728 | 41455 | 82911 |
| Decile 10 | 17225 | 34450 | 68901 | 137802 | 275603 |
| **Total** | **3333** | **6683** | **13365** | **26730** | **53460** |

*Source: Own calculations based on National Accounts Statistics (2006)*

In Table 15 the direct and indirect additional expenditures as a result of higher energy prices are added together to give the total impact on household expenditure. The lower panel gives the increase as a factor of total initial expenditure.

*TABLE 15: Total change in annual expenditure due to higher energy prices*

| Price of CO2 | | | | | |
|---|---|---|---|---|---|
| Euro/t | 25 | 50 | 100 | 200 | 400 |
| Rs/t | 1500 | 3000 | 6000 | 12000 | 24000 |
| | Total increase in expenditure | | | | |
| Decile 1 | 1489 | 2978 | 5957 | 11913 | 23826 |
| Decile 2 | 2249 | 4499 | 8997 | 17995 | 35989 |
| Decile 3 | 2282 | 4722 | 9443 | 18886 | 37773 |
| Decile 4 | 2568 | 5135 | 10271 | 20542 | 41084 |
| Decile 5 | 2853 | 5706 | 11412 | 22824 | 45649 |
| Decile 6 | 3138 | 6277 | 12553 | 25107 | 50213 |
| Decile 7 | 1926 | 3853 | 7706 | 15411 | 30822 |
| Decile 8 | 2097 | 4194 | 8388 | 16776 | 33552 |
| Decile 9 | 5814 | 11628 | 23257 | 46514 | 93028 |
| Decile 10 | 20117 | 40235 | 80469 | 160938 | 321876 |
| **Total** | **4453** | **8923** | **17845** | **35691** | **71381** |
| | **increase in total expenditure as a factor** | | | | |
| Decile 1 | 0.29 | 0.57 | 1.14 | 2.28 | 4.56 |
| Decile 2 | 0.29 | 0.57 | 1.14 | 2.28 | 4.56 |
| Decile 3 | 0.29 | 0.59 | 1.18 | 2.36 | 4.72 |
| Decile 4 | 0.29 | 0.57 | 1.14 | 2.28 | 4.56 |
| Decile 5 | 0.29 | 0.57 | 1.14 | 2.28 | 4.56 |
| Decile 6 | 0.29 | 0.57 | 1.14 | 2.28 | 4.56 |
| Decile 7 | 0.16 | 0.32 | 0.64 | 1.28 | 2.57 |
| Decile 8 | 0.16 | 0.32 | 0.64 | 1.29 | 2.58 |
| Decile 9 | 0.16 | 0.32 | 0.64 | 1.29 | 2.58 |
| Decile 10 | 0.17 | 0.34 | 0.67 | 1.34 | 2.68 |
| **Total** | **0.24** | **0.47** | **0.95** | **1.90** | **3.80** |

*Source: Own calculations based on National Accounts Statistics (2006).*

## 5.2 Household income

Table 16 shows the average annual household income by decile. The extreme degree of income inequality in India is clearly evident, in that deciles 1 to 8 have 18% of the wealth and deciles 9 and 10 have 82%. As no data is available for household size by income, the average for India of 5 people per household is taken.

*TABLE 16: Average annual household income by decile in 2005*

| Income group | Rs/annum | % of total | Av. HH size |
|---|---|---|---|
| Decile 1 | 5,220 | 3.9% | 5 |
| Decile 2 | 7,884 | 5.3% | 5 |
| Decile 3 | 8,000 | 1.1% | 5 |
| Decile 4 | 9,000 | 1.2% | 5 |
| Decile 5 | 10,000 | 1.4% | 5 |
| Decile 6 | 11,000 | 1.5% | 5 |
| Decile 7 | 12,000 | 1.6% | 5 |
| Decile 8 | 13,020 | 1.8% | 5 |
| Decile 9 | 36,100 | 25.6% | 5 |
| Decile 10 | 120,000 | 56.5% | 5 |
| Total | 23,222 | 100% | 5 |
| Poor | 8,517 | 18% | 5 |
| Middle | 45,280 | 82% | 5 |

*Notes:*
- *Disaggregated household size numbers for different income groups are not available*

*Source: Census (2001a), NCAER (2008) own calculations*

Upon the introduction of C&S, each person in the country will receive a personal allocation permit (PAP). The value of the PAP will depend on the market price of CO2. The average number of persons per household is used to calculate the average household income from PAPs, depending on the price of CO2 (see Table 17). The lower panel shows the percentage increase in household income by income decile that arises from the PAPs.

## 5.3 Net impact on households

Now that the impact of C&S on both household expenditure and income have been estimated, it is possible to calculate the net effect, i.e. income from PAPs minus additional expenditure arising from higher energy prices. Table 18 displays this net income impact on households by income decile. For each CO2 price level, the poorer nine deciles are net beneficiaries whilst the top decile is net losers by a fraction of a percentage point even at the highest CO2 price level. Their net overall expenditure decreases by just between 0.07% and 1.2% overall depending on CO2 price. The higher the price of CO2, the more accentuated are the differences across income deciles.

*TABLE 17: Household income from PAPs*

| | Euro/tonne | 25 | 50 | 100 | 200 | 400 |
|---|---|---|---|---|---|---|
| | Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| **Income group** | **HH size** | **PAP income per household (Rs per annum)** | | | | |
| All deciles | 5 | 27,825 | 55,650 | 111,300 | 222,600 | 445,200 |
| **Income group** | **Initial income** | **Factor Increase in income per household from PAPs** | | | | |
| Decile 1 | 5,220 | 5.33 | 10.66 | 21.32 | 42.64 | 85.29 |
| Decile 2 | 7,884 | 3.53 | 7.06 | 14.12 | 28.23 | 56.47 |
| Decile 3 | 8,000 | 3.48 | 6.96 | 13.91 | 27.83 | 55.65 |
| Decile 4 | 9,000 | 3.09 | 6.18 | 12.37 | 24.73 | 49.47 |
| Decile 5 | 10,000 | 2.78 | 5.57 | 11.13 | 22.26 | 44.52 |
| Decile 6 | 11,000 | 2.53 | 5.06 | 10.12 | 20.24 | 40.47 |
| Decile 7 | 12,000 | 2.32 | 4.64 | 9.28 | 18.55 | 37.10 |
| Decile 8 | 13,020 | 2.14 | 4.27 | 8.55 | 17.10 | 34.19 |
| Decile 9 | 36,100 | 0.77 | 1.54 | 3.08 | 6.17 | 12.33 |
| Decile 10 | 120,000 | 0.23 | 0.46 | 0.93 | 1.86 | 3.71 |
| **Total** | **23,222** | **2.62** | **5.24** | **10.48** | **20.96** | **41.92** |

*Source: National Accounts Statistics (2006) and NCAER (2008) and own calculation*

*TABLE 18: Net change in household budgets at various C02 prices*

| | Price of CO2 | | | | |
|---|---|---|---|---|---|
| Euro/t | 25 | 50 | 100 | 200 | 400 |
| Rs/t | 1500 | 3000 | 6000 | 12000 | 24000 |
| | Net income from PAPs minus higher expenditure | | | | |
| Decile 1 | 26336 | 52672 | 105343 | 210687 | 421374 |
| Decile 2 | 25576 | 51151 | 102303 | 204605 | 409211 |
| Decile 3 | 25543 | 50928 | 101857 | 203714 | 407427 |
| Decile 4 | 25257 | 50515 | 101029 | 202058 | 404116 |
| Decile 5 | 24972 | 49944 | 99888 | 199776 | 399551 |
| Decile 6 | 24687 | 49373 | 98747 | 197493 | 394987 |
| Decile 7 | 25899 | 51797 | 103594 | 207189 | 414378 |
| Decile 8 | 25728 | 51456 | 102912 | 205824 | 411648 |
| Decile 9 | 22011 | 44022 | 88043 | 176086 | 352172 |
| Decile 10 | 7708 | 15415 | 30831 | 61662 | 123324 |
| **Total** | **23372** | **46727** | **93455** | **186909** | **373819** |
| | Net change in household income as factor | | | | |
| Decile 1 | 5.05 | 10.09 | 20.18 | 40.37 | 80.73 |
| Decile 2 | 3.24 | 6.49 | 12.98 | 25.95 | 51.90 |
| Decile 3 | 3.19 | 6.37 | 12.73 | 25.46 | 50.93 |
| Decile 4 | 2.81 | 5.61 | 11.23 | 22.45 | 44.90 |
| Decile 5 | 2.50 | 4.99 | 9.99 | 19.98 | 39.96 |
| Decile 6 | 2.24 | 4.49 | 8.98 | 17.95 | 35.91 |
| Decile 7 | 2.16 | 4.32 | 8.63 | 17.27 | 34.53 |
| Decile 8 | 1.98 | 3.95 | 7.90 | 15.81 | 31.62 |
| Decile 9 | 0.61 | 1.22 | 2.44 | 4.88 | 9.76 |
| Decile 10 | 0.0642 | 0.1285 | 0.2569 | 0.5138 | 1.0277 |
| **Total** | **2.38** | **4.77** | **9.53** | **19.06** | **38.13** |

*Source: Own calculations based on National Accounts Statistics (2006).*

## 6 IMPACT ON INDUSTRY

This section examines the potential effect of C&S on Indian industries. Section 6.1 provides an overview of energy consumption and CO2 emissions, and projects the immediate costs of emissions under C&S, for the major sectors of the economy. Section 6.2 discusses some of the anticipated second order impacts. Section 6.3 addresses the issue of international competitiveness.

### *6.1 Energy use, emissions and CO2 costs by major sector*

Table 19 shows the GHG emissions from the energy sector for six main sectors in 2000. Agriculture is a special case as it consumes 21.9% of electricity but does not pay for it. The emissions from the electricity consumed by agriculture are counted in "Energy and transformation industries (incl. Electricity)". Energy and transformation industries (incl. Electricity) account for the largest share of emissions (47.73%), followed by industry (22.09%). Oil and gas industry which includes transport accounts for 12.49%. The residential sector (5.9%) and commercial and public services (2.77%) account for relatively smaller shares of emissions. The CO2 emissions are a direct multiple of the energy consumption.

*TABLE 19: CO2 emissions by sector in 2000*

| Sector | Industry (direct coal) + coal mining | Oil (transport) +oil and gas industry | Gas (residential) | Energy and transformation industries (incl. Electricity) | Biomass | Commercial | Other | Total |
|---|---|---|---|---|---|---|---|---|
| | Emission (tCO2) | | | | | | | |
| Share% | 22.09% | 12.49% | 5.90% | 47.73% | 4.70% | 2.77% | 4.31% | 100.00% |
| **TOTAL** | **164,324** | **92,907** | **43,918** | **355,037** | **34,976** | **20,571** | **32,087** | **743,820** |

*Source: Ministry of Environment and Forests (2008)*

Table 20 presents estimates of the costs of CO2 emissions by sector for various CO2 price levels. As could be expected, the impact relative to gross value added in the sector is highest in the case of energy transformation industries and industry and lowest in the case of commercial and public services.

*TABLE 20: Cost of CO2 emissions by sector in 2005*

| CO2 price | | | | | |
|---|---|---|---|---|---|
| Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| **Sector** | **Cost of CO2 emissions (Rs million)** | | | | |
| Industry | 246,486 | 492,972 | 985,944 | 1,971,888 | 3,943,776 |
| Oil and Gas industry and Transport | 139,361 | 278,721 | 557,442 | 1,114,884 | 2,229,768 |
| Residential | 65,877 | 131,754 | 263,508 | 527,016 | 1,054,032 |
| Energy transformation | 532,556 | 1,065,111 | 2,130,222 | 4,260,444 | 8,520,888 |
| Commercial | 30,857 | 61,713 | 123,426 | 246,852 | 493,704 |
| Other | 48,131 | 96,261 | 192,522 | 385,044 | 770,088 |
| **Total** | **1,063,268** | **2,126,532** | **4,253,064** | **8,506,128** | **17,012,256** |
| **Sector** | **Cost as a % of sectoral gross value added** | | | | |
| Industry | 36.50% | 72.99% | 145.99% | 291.97% | 583.95% |
| Oil and Gas industry and Transport | 10.58% | 21.15% | 42.31% | 84.62% | 169.24% |
| Residential | n/a | n/a | n/a | n/a | n/a |
| Energy transformation | 119.05% | 238.11% | 476.22% | 952.44% | 1904.88% |
| Commercial | 0.52% | 1.04% | 2.08% | 4.17% | 8.34% |
| Other | 1.82% | 3.65% | 7.29% | 14.59% | 29.17% |
| **Total** | **33.69%** | **67.39%** | **134.78%** | **269.56%** | **539.12%** |

*Notes:*

- *The National Accounts Statistics (2006) uses different sectoral classifications from the Indian National Communication (2008), so it is not possible to obtain the precise gross value added for the sectors. The percentage figures are approximations based on the nearest fit between the two sectoral classification systems. Energy transformation includes all electricity, whether for industry or agriculture.*

*Source: Own calculations based on National Accounts Statistics (2006) and Ministry of Environment and Forests (2008).*

Clearly, the more energy intensive a sector or firm's production process is, the more it will have to pay to purchase CO2 emission permits and therefore the higher will be its production costs. The higher costs may to some extent erode profits, although this depends on the extent to which producers can pass on their high costs to their customers (ultimately consumers). In India, the energy transformation sector does not pass on its full cost either to industry or to agriculture today. It is interesting however that all income group deciles except for the highest decile will be in a position to cover all the expected price rises in the retail sector from the income from C&S. It is thus possible that the energy price rises may be passed on to the consumer in future, provided the country is comfortable with this level of inflation.

### 6.2 Second order effects

However, if higher costs resulting from C&S are passed on to consumers, this will bring about changes in demand – so-called second order effects. In general, consumers are likely to purchase fewer carbon intensive goods (and services). Companies that are more energy efficient – or more labour intensive – will in general become more competitive and gain larger market shares. The introduction of C&S would favour traditional over commercial agriculture since the latter is far more energy intensive and would therefore face higher costs when CO2 emissions are restricted and traded. Some commercial farmers might shift over to organic production methods which utilise less fossil energy.

### 6.3 Export industries and international competitiveness

Firms producing for the export market face similar issues to producers of non-tradable goods and services, although the context is obviously the global economy. Faced with cost increases when CO2 permits have to be purchased, exporting firms will pass on those extra costs to their consumers to the extent that they can. Again, this depends on their market power, which in general will tend to be smaller than that of firms in the non-tradable sector given the extent of international competition. Of critical importance for such firms will be their relative carbon intensity as compared with their competitor firms.

In addition, all carbon-intensive exporters are likely to see demand patterns shift away from their products to some degree as consumers respond to higher prices. Domestically, there is currently no great possibility for import substitution of the most prominent imports, viz. petroleum products and precious gems, Intra-industry trade in particular is likely to contract more than other types of trade because of its inherent energy inefficiency.

In considering the potential impact of C&S on industries, it is perhaps worth noting again the objective of the United Nations Framework Convention on Climate Change (UNFCCC), which states the following:

""The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner."

*TABLE 21: Comparison of electricity generation costs under C&S*

| | | | CO2 price | | | | |
|---|---|---|---|---|---|---|---|
| | | Euro/tonne | 25 | 50 | 100 | 200 | 400 |
| | | Rs/tonne | 1500 | 3000 | 6000 | 12000 | 24000 |
| | | Rs/kg | 1.5 | 3 | 6 | 12 | 24 |
| **Energy source** | **Current cost** | | **Cost including CO2** | | | | |
| Coal | 4.74 | Rs/kWh | 5.9 | 7.1 | 9.5 | 14.3 | 23.9 |
| Diesel | 12 | Rs/kWh | 13.3 | 14.7 | 17.4 | 22.7 | 33.4 |
| Solar | 15 | Rs/kWh | 15 | 15 | 15 | 15 | 15 |
| Modern Biomass | 5 | Rs/kWh | 5 | 5 | 5 | 5 | 5 |
| Wind | 5 | Rs/kWh | 5 | 5 | 5 | 5 | 5 |

*Source: own calculations.*

## 7 OPPORTUNITIES FOR RENEWABLE ENERGY

One of the key aims of placing a price on CO2 emissions is to alter the balance of incentives between fossil fuels and renewable energy sources such as solar and wind. Table 21 provides a comparison of electricity generation costs for coal, wind and solar energy sources. Current costs are compared with those for coal under the various benchmark CO2 price levels. Solar PV becomes more competitive than coal only at the highest CO2 prices, but more competitive than diesel power at around 4000 Rs/tonne CO2. Modern biomass and wind are more attractive than coal or diesel even with the lowest CO2 price level.

By putting a price on carbon emissions, C&S will also incentivise greater efficiency in the use of energy that is derived from fossil fuels. Given the history of burden sharing in petroleum pricing and electricity price support in India, there is an opportunity to create market prices for fossil fuels without placing undue burden on the consumers or on industry. At the same time investments in renewables can now be made to prepare for the period after 2040 when the proceeds of sale of PAPs will cease. Those sectors and households that invest earlier in conservation and efficiency measures will be relative gainers while those that are slow to adapt will be net losers.

## 8 SUMMARY AND CONCLUSIONS

This study sought to identify the initial impact that a global Cap and Share scheme might have on India, based on a set of limiting assumptions. In particular, it attempts to quantify the immediate impact – i.e. before behavioural responses – on energy prices, the macro economy, household expenditure and income, industries and the competitiveness of renewable energy sources. The main findings are summarised as follows.

- India's per capita emissions are less than one quarter the world average. Emissions are dominated by those from coal, and have been on a rising trend since independence.
- Putting a price on CO2 emissions would have a major impact on the price of electricity, and on biomass, the two most important sources of energy in India. The impact on the prices of transport energy in India may be less, but will nonetheless be felt in the same way that oil prices rises in the last year had to be dealt with through burden sharing. Higher energy prices would also feed through into higher producer and consumer prices given that energy is embodied in the production process for many goods, and many goods and services have a transport cost component.
- Because of India's low per capita emissions, the net impact of C&S, taking into account the total cost of emission permits after adjusting for the balance of emissions embodied in trade as well as national income from PAPs, is a substantial, positive percentage of GDP.
- At the household level, C&S would effect a substantial degree of income redistribution within India given the existing extent of inequality in energy consumption and income. In particular, the richest income decile is a marginal net loser from C&S while the bottom nine deciles are net winners. In proportional terms, C&S has a progressive impact on inequality.

- The energy transformation industries, especially coal-powered electricity would be hard hit in terms of their pricing. Government of India would have to change its current electricity pricing policy, and pass on price hikes to consumers or industry for C&S to have the required neutralising effect on price rises.
- Overall C&S may give Government of India a chance to re-look at India's energy pricing policy for the period between say 2012 and 2040 when C&S is in place, when households have up to seventy times more income over all compared to their total income today depending on the price of CO2.
- Other energy-intensive industries, such as mining and metal production, have similar energy-intensities to their direct competitors in other countries, but could lose out to less energy-intensive competitors where those exist. Over time there is likely to be a relative decline in long-distance international trade.
- Renewable sources of energy become much more cost competitive than coal-fired electricity even at moderate CO2 price levels.

This exploratory study has hopefully demonstrated that more extensive research and analysis into the potential impacts of C&S is worth undertaking. For instance, more complex economic modelling could be applied to estimate some of the dynamic responses of industrial sectors and households to higher energy prices.

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## APPENDIX 1: FOSSIL FUEL SCARCITY RENTS

Burden sharing is currently costing the Government of India around 15 billion USD in 2008. Government of India may welcome a formula for burden sharing internationally, given that India is set to import 90% of crude oil by 2030. A benchmark IRR level may be proposed for deciding the share of rent to be given to the producer and the share to be distributed through the CoP for a C&S scheme.

### *How high is scarcity rent at present?*

The total amount of scarcity rent that fossil fuel producers have received since oil prices began their climb has been substantial. Most currently-active oilfields were developed on the assumption that the price of oil would be about $20 a barrel, the long-run average price between the early 1980s and the early 2000s. If one increases that figure to $30 to allow for inflation, more than half of the $1,975 billion paid for oil in 2007 when oil averaged $64.20 a barrel, was actually scarcity rent. It amounted to around $1,000 billion, roughly 2% of gross world product. Coal and gas producers also received scarcity rental payments but the oil part alone works out at $151 for everyone on Earth.

For the purposes of this paper, it is assumed that the oil producers come to an agreement with the Global Climate Trust to accept a price made up of their actual average production cost, which is assumed to be $30 in the first year in which C&S operates, and a share of the scarcity rent. The table shows the scarcity rental shares for each oil price which have been taken as the outer bounds of the range of possibilities at which an agreement might be struck.

*TABLE A1: Allocation of oil scarcity rents*

| Oil price in USD per barrel | Producers' share of scarcity rent (Max) | Min. rental captured by C&S from oil ($/barrel) | Producers' share of scarcity rent (Min) | Max rental captured by C&S from oil | Min. price per tonne of CO2 | Max. price per tonne of CO2 | Income range per person from selling permits for 3.71 tonnes in first year. |
|---|---|---|---|---|---|---|---|
| $60 | 100% | 0 | 20% | $24 | 0 | $53 | 0 - $197 |
| $100 | 90% | $7 | 17.5% | $58 | $16 | $128 | $59 - $475 |
| $150 | 80% | $24 | 15% | $90 | $54 | $200 | $200 - $742 |
| $200 | 70% | $51 | 13% | $148 | $113 | $329 | $419 - $1,220 |
| $250 | 60% | $88 | 11% | $196 | $196 | $435 | $727 - $1,614 |
| $300 | 50% | $135 | 9% | $246 | $300 | $546 | $1,113 - $2,026 |
| $350 | 40% | $192 | 7% | $298 | $427 | $662 | $1,299 - $2,456 |
| $400 | 30% | $259 | 5% | $352 | $575 | $780 | $2,133 - $2,894 |

*450kg of CO2 released/barrel of oil*

There is little possibility that the higher oil prices envisaged in the table would apply when C&S was introduced. They are much more likely to arise later when the cap on fossil fuels begins to get very tight and only extremely valuable fuel uses remain economic. In these circumstances, the per capita emissions allocation would be quite small. If this assumption turns out to be sound, the value of each person's allocation will never reach the highest figures in the table.

*TABLE A2: Allocation of oil scarcity rents @ the rate of 16% IRR*

| Production cost of oil ($/barrel) | Oil price in USD per barrel | Producers' share of scarcity rent | Rent captured by C&S from oil ($/barrel) | Price per tonne of CO2 | Income per person from selling permits for 3.71 tonnes in first year. |
|---|---|---|---|---|---|
| $30 | $60 | 16% | $25 | $56 | $208 |
| $30 | $100 | 16% | $59 | $131 | $485 |
| $30 | $150 | 16% | $101 | $224 | $831 |
| $30 | $200 | 16% | $143 | $317 | $1,177 |
| $30 | $250 | 16% | $185 | $411 | $1,524 |
| $30 | $300 | 16% | $227 | $504 | $1,870 |
| $30 | $350 | 16% | $269 | $597 | $2,216 |
| $30 | $400 | 16% | $311 | $691 | $2,562 |

*450kg of CO2 released/barrel of oil*

It is interesting to note that the 2007 edition of the OPEC publication, World Oil Outlook, which deals with the period up to 2030, builds much lower oil prices than at present into its projections. It states on page 15: "An emerging dominant impression is that in order to finance the necessary investments there appears to be a need for higher prices than previously thought. Indeed, this has become the understanding, tacit or otherwise, of both producing and consuming countries. Bearing these developments in mind, the reference case OPEC benchmark crude price is assumed to remain in the $50–60/bbl range in nominal terms for much of the projection period, rising further in the longer term with inflation. These price levels are, of course, no more than assumptions, and do not reflect or imply a projection of most likely price paths, or of the desirability of any given price." The 16% IRR in table A2 is a benchmark profit to producers that simplifies a more complex formula that would also take into account changing production costs.

### *The need to reduce the supply of C&S permits more rapidly than the fastest depleting fossil fuel*

Assume that the three fossil fuels are initially used in equal proportions in terms of MTOE but that the CO2 emissions from them are in the ratio 1 for gas, 2 for oil and 3 for coal. Also assume that oil output begins to decline at 8% a year as a result of resource depletion but coal production can increase by 2% pa. If enough permits are released to allow this. Gas output is flat. If the Global Climate Trust does nothing, world emissions will therefore fall by

$$\frac{(2 \times 0.08) - (3 \times 0.02)}{0.06} \text{ equals } 1.7\% .$$

At what rate should the Trust reduce the supply of permits? Should it cut their issue by a minimum of 1.7% each year or should it cut by the rate at which output of the fastest depleting fossil fuel is falling? The answer is that if it cuts by less than 8%, all three types of fossil fuel producer will still be able to get a scarcity rent. This is because there will be more demand for oil than the producers can supply. This will push up the price of oil by a scarcity rent element, widening the differential between oil price and those of other fuels, which will then rise accordingly as demand switches to the cheaper options. Thus, if the aim is to capture all the scarcity rent for the people of the world, the rate at which the GCT cuts the issue of permits has to be at least the rate of decline of output of the fastest depleting fuel. However, as a rent-sharing arrangement with the fossil fuel producers is necessary, cutting by less than the fastest decline rate would be one way of delivering it.

To stay within safe to achieve net zero emissions as quickly as possible (IPCC, 2007) as recommended by the IPCC and noted at Bali, a possible trajectory for reductions is:

| | | | |
|---|---|---|---|
| 2005 | 29.3 | billion | 3.7 per person |
| 2012 | 26 | billion | 3.7 per person |
| 2015 | 23 | billion | 2.8 per person |
| 2020 | 18 | billion | 2 per person |
| 2025 | 13 | billion | 1.4 per person |
| 2030 | 8 | billion | 0.8 per person |
| 2035 | 3 | billion | 0.3 per person |
| 2040 | 2 | billion | 0.17 per person. |

This is a cut of 1 billion PAPs per year, or a 3.85% cut in 2012, 4.17% in 2015, 5.26% in 2020, 7.14% in 2025, 11.11 in 2030, 25% in 2035, and a final 33% the following year to reach 2 billion PAPs only from then on. This represents a total of 358 billion PAPs for the period 2012 to 2040 and may prevent temperature rises above 2oC.

The CoP could choose to fix a benchmark IRR for all oil producers and leave the rest of the oil price as the CO2 price, thus creating a viable financing mechanism for the climate bank such as the GCT and a suitable income stream for all people on earth to compensate them for rising energy prices.

## PROJECT EXAMPLE

### *TABLE 22 Project Example - Renewable Cook Fuel Project India*

People receiving cap and share income can jointly engage in projects for enhanced food fuel and fodder production. These types of projects have not taken off under CDM as methodologies for the quantification of emission reductions for land-based projects are too complex and carbon prices are too low.

| | | | |
|---|---|---|---|
| **EXPENDITURE** | | | |
| **Salaries** | | | |
| **Item** | **Rs/yr** | **Number** | **Total** |
| Cook Stove Project India Manager | 300,000 | 1 | 300,000 |
| Data Manager | 180,000 | 1 | 180,000 |
| Accounts Manager | 144,000 | 1 | 144,000 |
| Horticulture Manager | 144,000 | 1 | 144,000 |
| Stove Manager | 120,000 | 1 | 120,000 |
| Fuel Preparation Manager | 120,000 | 1 | 120,000 |
| Village Reps | 24,000 | 200 | 4,800,000 |
| Admin officers | 60,000 | 5 | 300,000 |
| Village accountants | 36,000 | 5 | 180,000 |
| Technicians - Fuel and stoves | 60,000 | 10 | 600,000 |
| Agriculturists | 48,000 | 20,000 | 960,000,000 |
| **Sub-total** | | | |
| **Operation and Maintenance** | | | |
| **Item** | **No** | **Rs/unit** | **Total** |
| Stove build, repair, rebuild | 20,000 | 500 | 10,000,000 |
| Blade sharpening | 20,000 | 500 | 10,000,000 |
| Fuel deliveries - transport | 20,000 | 500 | 10,000,000 |
| Soil conditioning | 20,000 | 2,000 | 40,000,000 |
| **Sub-total** | | | **1,036,888,000** |
| **TOTAL EXPENDITURE** | | | |
| | | | |
| **INCOME UNDER CAP AND SHARE** | | | |
| 5 people/HH | Permits/person | Rs/Permit (1tCO2e) | |
| 100000 | 3.71 | 2794.846 | 1,036,888,000 |
| | | | |
| **ANALYSIS** | | | |
| **Impact of carbon price on cost of Kerosene** | | | |
| Price of permit | 2794.846 | Rs/tCO2e | |
| NCV Bamboo | 0.015 | TJ/tonne | |
| NCV Kerosene | 0.045 | TJ/tonne | |
| Kerosene required | 0.333 | Kg | |
| EF Kerosene | 2.149 | kgCO2/kg | |
| emissions from Kerosene | 0.716 | kgCO2 | |
| Price increase for equivalent Kerosene | 2.002 | Rs | |
| **CONCLUSION** | | | |
| Cap and share has a profound positive effect on the rural economy, and manageable effect on direct fossil fuel price. | | | |

## Massive gains for India's economy

Because most of its people use very little fossil energy, India would benefit massively from the global adoption of Cap and Share, a way of reducing greenhouse emissions that involves sharing globally the benefits from their use. Its national income could double.

90% of the population would stand to gain, and the more rapidly emissions were reduced, the greater their gains would be. For example, if the pace was rapid and the world price for emissions permits rose to €100 per tonne of CO2, the poorest 10% of Indians would see their total income increased twenty times. If the CO2 price was €200 per tonne, their incomes would be 40 times greater than today.

Only those Indians using a lot of energy would suffer in the short-term because they would have to pay more for their fuel than they received in compensation from the sale of their permits. Their net incomes would be reduced by 0.26% at €100/tonne of CO2 and 0.52% at €200. In the longer term, however, they could expect to become richer as a group because of the better business and professional opportunities the increase in the rest of the population's incomes would provide.

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