The potential impacts of a cap and share on the United States of America [1]

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Abstract: One quarter of global renewable energy technology (RETs) demand can be supplied by the USA using 10% of its installed electricity generation capacity over the period 2010 to 2020. In this way domestic demand for RETs will also be fully satisfied immediately and obviate the need for what would otherwise be an additional 20.06 tCO2e demand per person in the USA per annum compared with an equitable sustainable total supply of 37.5 Pollution Allocation Permits (PAPs) per person for the period 2010 to 2040, after which there are no PAPs. The impact of C&S on individuals in the USA is regressive and unless the Government of the USA intervenes the lowest income quintiles of the population will be severely impacted. To the extent that PAPs are traded, trade balances in $ in the US will shift from deficits with China to deficits with India and other PAP surplus countries and the $ and other Annex 1 currencies will loose value against the basket of currencies of the countries with a surplus of PAPs. The cost in $ of PAPs and their lack of supply will drive the shift to RETs both for domestic consumption and production and as the dominant or even only manufactured export good. Non-Annex 1 PAP surplus countries may need to continue to pressure on Annex 1 countries especially the USA to reduce their production and consumption of fossil-fuel energy intensive goods as global demand for PAPs outweighs supply, thus ensuring that global trade declines and the global sustainable emission reduction trajectory is complied with whilst at the same time leaving global trading space to Non-Annex 1 PAP surplus countries. For this, a new global monetary authority may be needed and a new global reserve currency measured against a basket of Non-Annex 1 country currencies. The value of Annex 1 country currencies will decline as their products are no longer in demand. The USA must pay its historic fiscal deficit into a global renewable energy/clean development mechanism fund, to which both Annex 1 and Non-Annex 1 countries can sell new style reformed CERs which are paid for in advance on a debt-free basis in their local currency and are retired by the fund.

Keywords: emission backed currency unit, cap and share

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[1] I would like to thank Richard Douthwaite for comments on this paper. I am responsible for all errors. e-mail address for the author: sharan.anandi @gmail.com

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1 Executive Summary

Under the Cap and Share system a global climate trust issues Pollution Authorisation Permits (PAPs) annually to all citizens on the planet equally, at a quantum that will guide the global emission reduction trajectory at a sustainable level and in a controlled manner. The cap and share system (C&S) has the feature of capturing the scarcity rent accruing to oil producers and energy and carbon traders and instead making money available to citizens to use for dealing with the rising price of energy. The potential income from selling their PAPs to their national oil and coal importers and producers through their post offices and banks gives citizens an income to offset the rise in energy prices. This report draws on current research to show that poorer Americans will be paying a significantly higher proportion of their incomes under C&S than richer ones. The American government must thus introduce internal redistributive measures to combat this. There is however the bonus that the C&S system would bring in terms of the capture - by all Americans - of a large part of the scarcity rent which would have otherwise gone to the fossil fuel producers if C&S had not been introduced. The global greenhouse gas emissions in 2006 are 30.95 billion tonnes of carbon dioxide equivalent, which is an average of 4.48 tCO_2e per person. Under C&S this value, less the 15% which will be paid into the Adaptation Fund for least developed countries, represent the Pollution Authorisation Permits in year 1. Thus the equitable sustainable allocation of PAPs in year 1 is 3.8 PAPs per person. In the USA individuals on "average" use 26 tCO_2e per person every year, which "averages" 20 tCO_2e per person more than the equitable sustainable allocation of PAPs in year 1. The economic impact of C&S on individuals, and on the country, including the inevitable impact on the currency, and on trade will be profound. In total, Americans will be allocated 1.21 billion PAPs in year 1 and will have to curtail their additional demand for just under 6.4 billion PAPs. Non-Annex 1 PAP surplus countries may or may not be willing to sell their PAPs to the USA, as they may wish to make them available to their own oil importers or coal producers. This will cause a depreciation of the USA $ and a new global trading currency may be needed or the currency from a strong non-Annex 1 PAP surplus country will take its place. In any case there will be continuous pressure from Non-Annex 1 PAP surplus countries and from Non-Annex 1 PAP deficit countries on Annex 1 countries to reduce consumption and production in order to keep the global community on a sustainable emission reduction trajectory.

National governments of PAP surplus countries may or may not regulate how many PAPs their citizens may sell to oil importers outside their country. Thus it is important for the USA to generate more renewable energy so that it can pay less of its national wealth to buy PAPs.

The initial impact on the US trade deficit assuming the full excess PAPs required by USA citizens are available, will be to increase the deficit even more. In addition the trade pattern will change as trade between the USA and those Non-Annex 1 countries that have a surplus of PAPs increases. In order to manage the decline of the value of the $ in a responsible way the US trade deficit with China and other $ rich countries will have to be managed by paying back this deficit into a global climate bank/CDM bank / renewable energy fund in a time bound regulated manner. The fund will use this money to provide non-debt finance for renewable energy and adaptation and forestry. But this is paid in domestic currency and may only to a small extent to be used to buy goods and services from Annex 1 countries. This trade too is in the context of PAPs being available in the relevant country to back any RETs manufacturing industry and other essential sector requiring limited amounts of fossil fuels in the transition period.

1.1 Aims of the study

This study aims to assess the initial impact of the introduction of a global C&S scheme on US households and balance of payments. Whilst the studies for cap and share as a concept (feasta, 2008), and the country studies for India (Sharan, 2008) and South Africa (Wakeford, 2008) are already available, the study is being done for China and will be available soon. In this context an assessment of the initial impact on the USA is of great importance, as it is the largest emitter of greenhouse gases and has the highest per capita level of emissions. The words initial impact need to be emphasised because the introduction of C&S would generate a new set of relative prices.

The initial effects to be explored are those on:

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

1.2 Scope

This report is not intended to be a comprehensive analysis.

1.3 Assumptions

The analysis is based on the following assumptions about the implementation of C&S:

- C&S is introduced globally now (2009). 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 *$ 50* per barrel to $400 immediately after C&S's introduction.
- Appendix 1 converts the scarcity rents into prices per tonne of CO_2 ($/PAP) 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 PAP prices range from zero to $ 780. The benchmark prices used in this study are $25, $50, $100, $200 and $400. it also shows the global cap.
- The prices of oil, coal, gas, biomass, and food are assumed to maintain their current relationship with the oil price after allowing for the effects of the CO_2 price.
- The price of biomass and renewable energy and food is assumed to shadow the price of fossil fuel energy sources.
- 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 CO_2 emission allowance is assumed to be 3.8 tonnes per capita. This figure is based on the EIA's (2006) estimate of average global emissions of 4.48 tonnes of CO_2 per person, less 15%.
- 5% for the Transition Fund, 9% to pay for sequestration and 1% for overheads will go to the Adaptation Fund under the UNFCCC thus meeting some old elements of the commitments made by Annex 1 countries under the UNFCCC for small least developed countries.

1.4 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.

1.5 Data

This study utilises data mainly from the US Energy Information Administration (EIA). 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 2008.

2 Overview of cap and share scheme

C&S 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. The new climate trust, which takes charge of these PAPs, controls the quantum at the global sustainable emission reduction trajectory level. The income from selling their PAPs 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. Coal is covered not only because it is also a fossil fuel that emits greenhouse gases, but because, like oil and gas, global output of coal has also peaked, and it is thus increasingly scarce. C&S is a way of capturing the scarcity rent of fossil fuel energy - the extra that consumers are prepared to pay when whatever they are consuming gets scarce - and redistributing it globally. 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. In 2009 this badly managed global economy stumbled into a deep recession. The global economy was not able to give those who needed energy the money to buy it with. Under C&S, the level of emissions permitted under the cap is reduced year by year at whatever rate the international community decided is necessary to guarantee climate stability. The overall rate of decline of PAPs issued needs to be at least as fast as oil production is declining if the maximum amount of scarcity rent is to be available for distribution. This is because, to capture the most rent, the emissions permits issued under the cap have to be a scarcer resource than the oil supply. There will be currency realignments and severe competition for PAPs during this period. 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. In order for C&S to function as a benign economic tool for managing the transition to a period when oil is no longer available, the PAPs issued every year must be less than the oil that is available. In other words, as we know that oil is declining by between 6-9% every year, the number of PAPs issued must decline by more than 9% every year. Studies show that coal supplies are declining too.[3] The decline of supply is measured in the reserves-to-production (R/P) ratio - the number of years the reserves would last at the current rate of consumption, The R/P ratio

[2] *Financial Times*, London, 29 October, 2008
[3] *http://www.trec-uk.org.uk/articles/NS_2008-01-19.html*

had dropped from 277 years to just 155. In 2006, according to the BP Statistical Review of World Energy, the R/P fell again, to 144 years. C&S is thus also a response to coal peak. Instead of leaving the difficult question of "what to do about coal" to the market, C&S will restrict coal consumption too to the sustainable global level to ensure climate stability. C&S will increase fossil fuel prices by an amount based on the additional scarcity it had created for climate reasons. This means that we are assuming that peak oil and peak coal are realities and that high energy prices are here to stay no matter what, but that output has to be limited even more, faster, for climate change mitigation reasons. The extra money that people in Non-Annex 1 PAP surplus countries pay for their fuel because of this climate surcharge is returned to them in one way or another. In Annex 1 countries such as the USA the extra money will not cover the whole price rise. C&S is not a tax. C&S retrieves some of the money currently being paid to fossil fuel producers as scarcity rent and distributes it around the world. It has therefore the potential to make the majority of the world' people better off. C&S shares the scarcity rent by distributing most of the emissions permits issued under the cap directly to individuals, who then sell the PAPs at whatever is the current market price, to financial intermediaries such as banks and post offices. The intermediaries then consolidate the PAPs and sells them on to fossil fuel producers who are required to buy sufficient PAPs each year to cover the emissions from the fuel they have produced. Inspectors ensure that they comply and the global bank manages the supply of PAPs. Until efficiency and renewable energy measures begin to kick in, Annex 1 country governments may have to provide direct support to households to help them buy PAPs outside their own country in one way or the other to sell to their oil importers. If oil importers do not have PAPs they cannot import oil and coal producers cannot produce coal.

The concept of regulating a noxious gas by turning it into a commodity is not new in the USA. The Clean Air Act of 1990 was a system to enable government to control polluters by capping pollution and giving polluters the right to trade emission rights amongst each other, in this way cutting U.S. sulphur dioxide emissions without infringing market freedoms too much. But this system created rights in a commodity for a very limited number of players. Suddenly a "bad" becomes a "good" to be bought and sold, and made profits with, by just a few. The Clean Development Mechanism under the UNFCCC has similar disadvantages, creating windfalls for polluters who marginally improve their polluting systems, and providing practically no support for truly additional projects for people who do not have money. For this reason a reformed CDM/renewable energy fund is proposed to supersede CDM as it is today, and C&S is proposed as alternative to cap and share.

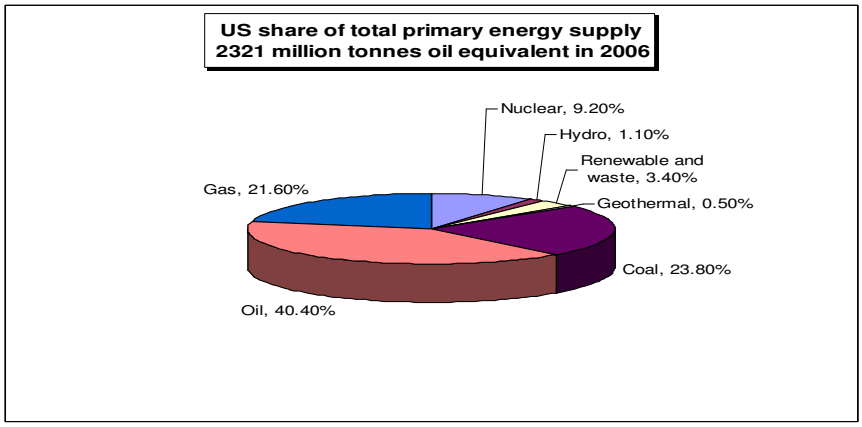
C&S gives Non-Annex 1 PAP surplus countries a new source of debt-free income and changes international trade flows between Non Annex 1 PAP surplus countries, Annex 1 PAP deficit countries and the Non-Annex 1 PAP deficit countries. Under C&S global trade will be backed by 30.9 billion PAPs in year 1 down to 0 PAPs in year 2040, thus valuing the global energy economy at between 0.77 trillion $ at a price of 25$ / PAP and 12.38 trillion $ at a price of 400 $ / PAP, excluding the producer share. This is the scarcity rent captured from fossil fuel energy producers to be exchanged for fossil-fuel based goods and services once the PAPs have been encashed. All investments, whether in manufacturing renewable energy technologies (RETs) or anything else must be backed by PAPs. The implications of this for the USA are analysed below.

3 US Background

3.1 Energy supply and consumption

In 2008 petroleum constituted 47% of the balance of trade deficit in the USA. US petroleum consumption constitutes 22.6% of total global consumption. The USA has the largest coal reserves in the world at 242'721 million tonnes.

Figure 1: Share of total primary energy supply in the USA in 2006



3.2 CO2 emissions

The USA is the largest emitter of CO_2 (from energy consumption) on a per capita basis. In 2006, per capita CO_2 emissions (19.78 tonnes per capita) were more than four times the global average (4.48). Its emissions in 2007 were 17% higher than in 1990.

Table 1 Emissions in selected countries and regions in 2006

	CO_2 emissions in 2006		
	t/$000 (PPP)	t/$000 (MER)	t/capita
Europe	0.36	0.45	7.99
Eurasia	1.14	4.49	9.11
West Asia	0.87	1.84	8.04
Latin America	0..34	0.61	2.51
Africa	0.48	1.33	1.16
Asia Oceania	0.66	1.04	3.07
World	0.55	0.77	4.48
USA	0.52	0.52	19.78
Canada	0.58	0.73	18.81
Australia	0.67	0.9	20.58
Russia	1.05	4.85	12
Brazil	0.27	0.54	2.01
China	1.12	2.84	4.58
India	0.55	1.78	1.16
RSA	1.66	2.65	10.04

The figures do not include embedded emissions.

3.3 Socio-economic context

C&S has a regressive effect on individuals in high energy consuming countries like the US. The lower their income, the more their energy cost burden. There will have to be welfare schemes to alleviate suffering through quantitative monetary easing. In the USA the present restructuring of the economy to deal with the threat of climate change increases the burden on the poor. Average per capita emissions are 26 tCO_2e in the US but the globally equitable and sustainable level of PAPs today is 3.8 tCO2e per person per year. In this situation it is not the cost of PAPs but their supply that will force production and consumption do decline substantially in the USA.

4 Impact on Prices

Restrictions on the use of fossil fuels will raise their price and the price of electricity. The price effects from buying in additional PAPs to cover the energy consumption by US individuals over and above their equitable sustainable entitlement, is shown in Table 3. Grainger and Kolstad, (2008) calculate emissions through the US economy and provide estimates of emissions attributable to the consumption of final goods. They use a Carnegie Mellon version of the US input-output model (the "CMU Model"), to estimate the amount of emissions associated with each consumption category in the Consumer Expenditure Survey (CES). On a per-capita basis, this implies an 'average' consumer's emissions of about 26.4

metric tons of CO2e, compared to estimates of 24.3 by the EPA. The energy price rises from buying PAPs from other citizens globally ranges from 2% of total current annual expenditure for the richest quintile when the price for 1 PAP is 25 $, to 58% for the poorest quintile when the price is 400 $/PAP. It should be understood that once C&S is in place it is illegal to consume fossil fuel energy that has not been bought with PAPs.

4.1 Indirect price effects

Indirect price effects are taken into account in the total per capita emissions figure per quintile. The estimates are first order and partial equilibrium. They assume all costs are passed on to consumers; workers and capital owners bear none of the costs. Furthermore, they only estimate the burden of the carbon tax, not taking into account consumer and firm response to a higher carbon price in terms. Is it assumed that costs of reducing emissions are ultimately passed on to consumers regardless of the point of compliance.

4.2 Income to US citizens from sale of PAPs

Table 2 shows the income from sale of PAPs to US citizens in so far as they choose to sell them. If they do not sell their permits they are in effect challenging the national economy to supply them with renewable energy instead. If households sell their PAPs they will get between 95 and 1520 $ per year in the first year. For the poorest quintile this represents 0.8% of their total mean annual personal expenditure and 12.7% for the poorest quintile at the 400$ price level. As a percentage of the energy price rise it represents between 12.6% for the richest quintile to 21.9% for the poorest quintile.

Table 2 Impact on household expenditure of income from sale of PAPs

Estimated effect by Income Quintile in $					
PAP price					
$/PAP	25	50	100	200	400
Income from C&S in $					
Quintile 1	95	190	380	760	1520
Quintile 2	95	190	380	760	1520
Quintile 3	95	190	380	760	1520
Quintile 4	95	190	380	760	1520
Quintile 5	95	190	380	760	1520

As % of mean per capita annual expenditure					
Quintile 1	0.8%	1.6%	3.2%	6.3%	12.7%
Quintile 2	0.7%	1.4%	2.8%	5.5%	11.1%
Quintile 3	0.6%	1.1%	2.3%	4.6%	9.2%
Quintile 4	0.5%	1.0%	1.9%	3.8%	7.6%
Quintile 5	0.3%	0.6%	1.3%	2.5%	5.0%

As % of price rise	
Quintile 1	21.9%
Quintile 2	20.0%
Quintile 3	18.0%
Quintile 4	16.0%
Quintile 5	12.6%

Ideally the US government is going all out right now to increase renewable energy supply in effort to avoid not only these costs but the shortage of PAPs. Table 3 shows the effect on individual expenditure of the rise in energy prices for the additional fossil fuel energy consumption over and above their equitable sustainable entitlement under C&S.

4.3 Income and expenditure

As the two lowest income quintiles of American citizens have higher levels of expenditure than they have income today, it is reasonable to assess the effect of energy price increases on expenditure. The direct income for these groups is supplemented from other sources. Even the third quintile has only marginally less expenditure than income. This data is reflected at the national level in the overall US negative savings rate. Overall, the burden of adjustment in the US will be born by poorer people unless the government intervenes. The total level of additional expenditure in the US economy to cover the demand is given in Table 4. The analysis overstates the burden on consumers since in actuality factors of production will bear some of the cost and, further, a higher price of PAPs and the shortage of supply will induce actions to reduce fossil fuel consumption and thus tax burden.

Table 3 effect on individual expenditure in the USA of cost of PAPs

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
Total Per-Capita Emissions in tCO2e/year above the equitable sustainable allocation	17.34	18.96	21.15	23.71	30.13
Cost of PAPs from other countries					
$/PAP	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
25	433.5	474	528.75	592.75	753.25
50	867	948	1057.5	1185.5	1506.5
100	1734	1896	2115	2371	3013
200	3468	3792	4230	4742	6026
400	6936	7584	8460	9484	12052
Cost of PAPs from other countries as % of total current personal expenditure					
$/PAP	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5
25	4%	3%	3%	3%	2%
50	7%	7%	6%	6%	5%
100	14%	14%	13%	12%	10%
200	29%	28%	26%	24%	20%
400	58%	55%	51%	48%	40%

Table 4 Additional PAPs to be bought to cover needs of US citizens

US population	317,641,000
Average PAPs per person required from non-US citizens	20.06
Total PAPs to be bought in year 1 in an unconstrained world	6,371,878,460

4.4 Impact on the Macroeconomy

C&S will have an impact on US exports and imports to the extent that the embodied fossil energy and therefore carbon dioxide in goods and services must be backed by PAPs and the USA will emit in the next 2 years its entire equitable sustainable per capita emission entitlement under C&S. It is the biggest PAP deficit Annex 1 country as it needs 6.4 billion PAPs in year 1 more than it has. For every 1 PAP it receives it has to cut demand for 10.

4.5 Balance of payments

Table 5 shows the cost of 6.4 billion PAPs at different price levels. It shows that at a price level of 25 $/PAP the cost is 1% of GDP and 23% of 2010 projected military spending. At 100$/PAP the cost is 4% of GDP and 93% of military spending. At 400$/PAPs the cost is 18% of GDP and nearly four times current military spending. Unless the US economy becomes vastly more efficient the current fiscal deficit will increase one and a half times at the highest PAP price level. On the other hand at the 100$/PAP level the cost matches the current military expenditure and thus if military expenditure is avoided there will be no extra outflow. The question of the price level is however an important unknown. The scarcity rent of oil will determine the price of PAPs. This is examined in the section on macro economic impacts.

Table 5 Cost of excess demand for PAPs in the USA in Year 1

	PAP price				
$/PAP	25	50	100	200	400
Cost in billion $	159	319	637	1274	2549
As % of 2008 US GDP	1%	2%	4%	9%	18%
As % of military spending in 2010	23%	46%	93%	186%	372%
As % of fiscal deficit for 2009	9%	18%	36%	73%	145%

Table 6 shows the list of countries with surplus PAPs. It is seen that the USA will be a purchaser of 68% of total surplus PAPs in the market in year 1. This is not quite the whole story however, as there will be competition for these PAPs from these countries themselves, as well as from other Annex 1 countries and also from Non-Annex 1 PAP deficit countries (Non-Annex 1 countries with emissions greater than 3.8 tCO2e per person per year). Total net requirement for these two groups is over 9.3 billion PAPs in year 1. The demand for around 16.1 billion PAPs for Non-Annex 1 PAP deficit countries, Annex 1 PAP deficit countries and the USA faces a supply of just under 10 billion PAPs from the PAP surplus countries listed in Table 6. If we include the 4.6 billion PAPs that will comes into the global energy economy from the Adaptation Fund demand and supply should match. But this scenario assumes that PAP surplus countries sell their PAPs. This issue is examined in section 3.6 under the question of the impact on the US trade balance. Table 7 shows the impact on the US trade balance at different PAP price levels.

Table 6 Non-Annex 1 countries with surplus PAPs

PAPs available with Non-Annex 1 countries with less than 3.8 tCO2e emission per person per year in 2006	
Country	**PAP surplus**
Chad LDC GHI	43,473,718
Afghanistan LDC (GHI?)	109,894,166
Democratic Republic of the Congo LDC GHI	255,017,837
Burundi LDC GHI	31,972,287
Cambodia LDC GHI	56,487,810
Uganda LDC GHI	126,420,095
Mali LDC GHI	49,766,105
Ethiopia LDC GHI	317,078,777
Malawi LDC GHI	58,461,586
Burkina Faso LDC GHI	60,673,115
Central African Republic LDC GHI	16,783,330
Rwanda LDC GHI	38,170,458
Lao People's Democratic Republic LDC GHI	23,869,183
Niger LDC GHI	58,792,174
Nepal LDC GHI	110,273,357
Lesotho LDC GHI	7,696,482
United Republic of Tanzania LDC GHI	165,681,206
Madagascar LDC GHI	73,788,081
Guinea LDC GHI	37,750,882
Eritrea LDC GHI	19,046,658
Comoros LDC GHI	2,512,863
Liberia LDC GHI	14,527,837
Gambia LDC GHI	6,319,267
Sierra Leone LDC GHI	21,018,539
Haiti LDC GHI	36,566,614
Zambia LDC GHI	47,362,181
Mozambique LDC GHI	83,267,400
Myanmar LDC GHI	178,049,307

Guinea-Bissau LDC GHI	5,799,760
Bangladesh LDC GHI	577,122,495
Kenya GHI	142,993,063
Timor-Leste LDC GHI	4215600
Sudan LDC GHI	150,399,983
Ghana GHI	8,455,930
Benin LDC GHI	31,905,135
Côte d'Ivoire GHI	74,090,728
Kiribati LDC	343,804
Tuvalu LDC	38,000
Solomon Islands LDC	1,831,340
Cameroon GHI	67,750,991
Togo LDC GHI	22,698,551
Senegal LDC GHI	42,822,650
Bhutan LDC	2,344,613
Vanuatu LDC	810,296
Sao Tome and Principe LDC	541,794
Paraguay GHI	20,816,887
Sri Lanka GHI	65,199,600
Cape Verde	1,631,478
Nigeria GHI	480,077,152
Pakistan GHI	558,600,283
Samoa LDC	537,749
Philippines GHI	279,995,995
Papua New Guinea	20,528,356
Nicaragua GHI	17,348,817
Yemen LDC GHI	71,745,654
Zimbabwe GHI	37,371,416
Guatemala GHI	41,664,705
Swaziland GHI	3,470,953
El Salvador GHI	17,844,930
Kyrgyzstan GHI	15,822,965
Mauritania LDC GHI	9,586,202

Georgia GHI	11,812,743
Honduras GHI	21,181,677
Morocco GHI	89,482,937
Peru GHI	81,033,480
Tajikistan GHI	19,390,903
Viet Nam GHI	241,663,971
India GHI	3,202,273,334
Indonesia GHI	602,359,134
Albania GHI	7,893,824
Namibia GHI	5,492,988
Tonga (GHI?)	254,332
Dominica	163,737
Bolivia GHI	24,266,749
Costa Rica GHI	11,081,797
Colombia GHI	110,275,003
Fiji GHI	1,992,518
Congo (GHI?)	8,672,265
Saint Vincent and the Grenadines	225,495
Republic of Moldova ** GHI	7,376,513
Angola LDC GHI	38,609,195
Uruguay GHI	6,588,310
Ecuador GHI	26,455,697
Dominican Republic GHI	19,549,858
Egypt GHI	158,768,549
Brazil GHI	350,630,579
Maldives LDC	557,616
Tunisia GHI	18,044,098
Guyana GHI	1,258,291
Saint Lucia	265,890
Botswana GHI	2,791,521
Cuba GHI	14,332,723
Syrian Arab Republic GHI	24,632,493
Algeria GHI	34,481,228

Mongolia GHI	2,414,803
Grenada	79,651
Gabon GHI	1,140,999
Mauritius GHI	751,427
Cook Islands	10,478
Democratic People's Republic of Korea GHI	10,606,507
Jordan GHI	2,795,646
Belize	112,822
Armenia GHI	1,003,403
The former Yugoslav Republic of Macedonia GHI	620,519
Saint Kitts and Nevis	11,712
Lebanon GHI	455,856
Iraq (GHI?)	3,321,820
Thailand GHI	592,811
TOTAL	9,994,907,087
US must buy	6,371,878,460
US must buy as a % of available surplus	68%

4.6 Impact on US trade balance

Table 6 points to a possible changed trade relationship between the USA and the rest of the world. The biggest shift is away from China to India, Pakistan, Bangladesh, Nepal and Indonesia, who between them have more than 50% of global PAP surpluses. African countries and Latin American countries, led in terms of size by Democratic Republic of Congo, Ethiopia and Nigeria in Africa, and Brazil in Latin America, will also have better trade balances with the US and other Annex 1 countries. The impact of C&S on other countries including these will be explored in later papers in this series. These PAP surplus countries have prospects of an exchange of green technology paid for in PAPs. For China and other Non-Annex 1 countries holding $ reserves on the other hand it is important for the USA to commit to paying its historic trade deficit back and not unilaterally devaluing its currency. To satisfy China and other historic debtors, the USA must pay its debts back into a global climate trust bank which the trust bank will use as debt free financing to pay for the global New Green deal and in this way adjust the value of the $ gradually against the PAP. These issues will be dealt with in more detail in each country study.

Table 7 Impact on US balance of trade

PAP price					
$/PAP	25	50	100	200	400
Cost in bn $	170	341	681	1,363	2,726
Trade balance 2008 in bn $	-800	-800	-800	-800	-800
trade balance after buying PAPs in bn $	-970	-1,140	-1,481	-2,163	-3,526

Assuming for the time being that one way or another the US gets all its PAPs, the USA will be buying 68% of the PAPs allocated to citizens in the countries listed in Table 7. Out of the 49 least developed countries (LDCs) only Djibouti and Equatorial Guinea will not have any surpluses to sell. And of this list of PAP surplus countries all countries except Tonga, Dominica, Saint Vincent and Saint Lucia, Grenada, Cook Island and Belize, and Congo, Afghanistan and Iraq – for which there is no data – are in the Global Hunger Index. US trade with these countries in PAPs will represent a useful inflow of debt free money for these poorest countries and a just redistribution of the scarcity rent on oil.

However, one has to remember that this outflow to the extent that it happens is a direct cost to citizens in the US in terms of higher energy prices. Individuals in the US will not be able to finance their PAPs with the traditional kinds of US exports, which have been as energy intensive as their imports. The US trade deficit as shown in Table 7 may not be healthy for the world economy and it may be better for PAP surplus countries to finance their development from internal sources, thereby using their own PAPs to build RETs and other essential manufactured goods and livelihood infrastructure.

The faster the US decarbonises its economy, the faster the immense pressure on individuals and households of rising energy prices will be lifted at home. In the USA, the balance of emission embodied in trade in the USA is only -7.3% and this figure is already taken into account in the emission figures for individuals and the consequent impact on individuals of higher energy prices in Table 3 above. One can deduce from this that as imports decarbonise, so will exports. This discussion also answers the question of what Non-Annex 1 countries with surplus PAPs might actually want from the USA. The single most important essential manufactured good for which there will be steady demand is renewable energy systems and technologies.

Provided they USA retools for the renewable energy age domestically, it may cover the costs of limited numbers of additional PAPs with exports of RETs. For an adequate renewable energy technology supply, any country whether with surplus or deficit PAPs needs PAPs to pay for the embedded emissions in the raw materials for manufacturing RETs. Assuming a similar energy input per MW of renewable energy as for a coal fired power plant, and assuming a world carbon intensity of 0.77 metric tonnes of carbon dioxide emission per 1000 $, and assuming a cost for a 750 MW super-critical (high efficiency) coal fired generator of 1.44 million $ per MW, the emission intensity of commercial energy whether renewable or coal is 1109 PAPs/MW, or 1.1 PAP per kW. Thus the global climate system may afford enough PAPs to give everyone 1 kW of RETS as the total equitable sustainable supply of PAPs for one individual for the period 2010 to 2040 including the supply from the Adaptation Fund is 44 PAPs. At the modest and efficient level of just 1 kW of installed RETs capacity per person, just 2.5% of global PAPs would be needed.

Now we may examine how much of the global requirement the USA may want to supply, and in this way engage in export trade of RETs. With a current level of installed electricity capacity of 1,031,978 MW in the USA and at 1788 MWh/MW and 2007 generation of 4,156,745,000 MWh, the USA could allocate 10% of its generation every year to manufacture 2,324,298 MW of RETs in 10 years. This is around ¼ of global demand. For this electricity, assuming it is coal-fired, the USA would have to have 2.6 billion PAPs. Total PAPs allocation to the USA for the period 2010 to 2040 is 14.6 billion PAPs. Assuming they have no PAPs to spare from their own equitable sustainable allocation but have to buy the PAPs from PAP surplus Non-Annex 1 countries, the cost for 2.6 billion PAPs would be between 64.5 billion $ at 20 $/PAP price and 1.03 trillion $ at 400 $/PAP. Instead of buying 6.4 billion PAPs in just one year to cover profligate energy consumption by consumers which anyway no one is going to give them, let alone sell, the USA should reduce all imports of fossil fuel intensive goods, reduce the energy intensity of the consumption patterns of Americans, and buy 2.6 billion PAPs over 10 years from Non-Annex 1 surplus countries in order to build up its RETs industry. The cost of this is shown in Table 8. One third of the USAs tCO_2e demand today without energy efficiency and lifestyle changes in just one year, would free up enough PAPs to supply ¼ of global RETs demand. It would also create new jobs, and as jobs in the RETs sector are already the fastest growing sector in the USA today this would be a realistic target.

We should remind readers that currently the average excess emissions across the quintiles in the USA is 20 tCO2e per year, whilst total equitable sustainable allocation of PAPs per person from 2010 to 2040 is 37 PAPs over thirty years. This shows just how dramatic the reduction of non-essential consumer energy consumption and production in the USA must be in order to release precious PAPs for renewable energy development especially in Non-Annex 1 countries, where 81% of world population lives.

Table 8 Cost of PAPs for RETs industry in the USA 2010 to 2020

	CO2 price				
$/PAP	25	50	100	200	400
	Cost of 2.6 billion PAPs to back the supply of 1/4 of global RETs needs				
Billion $	64.4	129	258	515	1,031

How does this impact the demand for PAPs from private individuals in the USA? Individuals must stay within their equitable and sustainable level of 3.8 tCO2e emission per year in 2010, reducing to 0 in 2040. If we assume 0% GDP growth, the carbon efficiency of the US $ domestically must rise from 1723 $ / tCO_2e today to 11818 $ / PAP. As the average expenditure in the second lowest quintile of the population is 12'006 $ / year, the carbon efficiency gains mentioned will be hardest to achieve for the poor as they have no spare income to allocate to new investments.

As the USA curbs its demand for PAPs it releases PAPs in the global economy for the use of Non-Annex 1 PAP surplus countries who as we have seen need fossil fuel energy for food security and sustainable development. The USA can contribute renewable energy technologies for meeting the new IPCC Millennium Goal for energy and constitute to sustainable development. By curbing its energy demand the USA will also remove the threat from Islamic terrorism and the nuclear arms race, as its international hegemony will be over.

Finally it is also important for the US to pay its historic fiscal deficit into the new global climate trust and in this way make additional green investment globally with debt free $ through the climate bank. This historic US fiscal deficit, which is currently at 12.3% of GDP must also be made to work for the new renewable global economy. The exchange rate between the $ in which the US fiscal deficit is denominated, and PAPs is thus of great interest. An aside is here that the value of the $ is of great concern to China in all this as it has its national savings denominated in $.

Thus for a while a new style CDM which is a debt free renewable energy fund financed from the repayment from the US historic build up of the fiscal deficit will help all countries in their own local currencies build renewable energy systems, provided they pay for the fossil energy they need for doing this with their PAPs. The reformed CDM/Renewable Energy Fund is a useful tool for national level restructuring and gradually adjusting the value of the $ to the PAP. The climate bank will act as a purchaser of new style CERs to be retired and not traded. These new style CERs can be supplied by any country, whether Non-Annex 1 or Annex 1, to the global bank, in return not for PAPs but for a flexible non-tradable CER price paid in advance in the national currency to build renewable energy and other climate change resilience-building capacity and may be fixed according to the project costs. In this context it should be remembered that all fossil-fuel energy capacity in all countries in the last 200 years until structural adjustment and neo-liberalism in the 1990 was built with debt free money.

5 Impact on Industry

The key industry is the renewable energy industry, which is covered above. All other industries will have to generate their own captive renewable energy or buy it from new government led RETs generating stations or face closure.

5.1 Second order effects

As the 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.

5.2 Export industries and international competitiveness

Faced with cost increases exporting firms will pass on those extra costs to their consumers to the extent that they can. Carbon-intensive exporters are likely to see demand patterns shift away from their products as consumers respond to higher prices and the USA contains its demand for PAPs to within its equitable sustainable limit. Domestically, import substitution of the most prominent imports, viz. petroleum products must take place, and energy inefficiency will have to be eliminated.

6 Opportunities for Renewable Energy

Table 9 provides a comparison of electricity generation costs for coal, wind and solar energy sources in the USA today. Current costs are compared with those for coal under the various benchmark PAP price levels. Solar PV becomes more competitive than coal only at the highest PAP prices, but more competitive than diesel power at less than 50$ per PAP. Modern biomass and wind are more attractive than coal or diesel even with the lowest PAP price level.

Table 9 Comparison of electricity generation costs under C&S

Current price		
Fuel	Price	
Coal	$/kWh	0.1135
Diesel	$/kWh	0.17
Solar	$/kWh	0.25
Modern Biomass	$/kWh	0.15
Wind	$/kWh	0.08

Price under C&S						
Price of PAP						
	$/PAP	25	50	100	200	400
Price of fuel including cost of PAP						
Coal	$/kWh	0.129	0.1445	0.1755	0.2375	0.3615
Diesel	$/kWh	0.228	0.286	0.402	0.634	1.098
Solar	$/kWh	0.25	0.25	0.25	0.25	0.25
Modern Biomass	$/kWh	0.11	0.11	0.11	0.11	0.11
Wind	$/kWh	0.05	0.05	0.05	0.05	0.05

7 Summary and Conclusions

This study sought to identify the initial impact that C&S might have on the USA, 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, individual expenditure and income, industries and the competitiveness of renewable energy sources. The main findings are summarised as follows.

- The USAs per capita emissions are too high to sustain and must be brought down.
- Higher energy prices will 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.
- During the short period of high prices before these behavioural and energy source changes occur the impact of price rise is likely to be the highest on the poorest quintiles of the population. Welfare measures will be urgently needed.
- C&S will have a major impact on trade patterns as PAP surplus Non-Annex 1 countries have greater economic power. The impact on individuals in the US will be severe and the best policy option is to supply all US citizens with 1 kW of renewable energy immediately and buy a limited number of PAPs over 10 years to use the USAs immense electricity generation capacity to manufacture RETs. The cost of PAPs for this will not exceed 1 trillion USA $ at the highest expected price of PAPs.
- Without behavioural and energy supply sector changes the US will have to buy 68% of the PAPs available globally from Non-Annex I surplus PAP countries.
- The US must pay back its fiscal deficit into a global green fund for debt free financing of the transition to a renewable energy economy globally. China will thus see its trade with the US decline over time as both countries compete to supply renewable energy technologies to third parties especially PAP surplus Non-Annex 1 countries.
- PAP surplus Non-Annex 1 countries will use most of their PAPs for the raw materials associated with the RETs industry. PAPs could be in very short supply and the global trust has a challenging time ahead to keep PAP volume within on a global sustainable emission reduction trajectory. All PAP surplus countries are listed in the Global Hunger Index as countries with a food deficit. Thus C&S will promote global justice.
- The high intensity fossil fuel energy transformation industries, especially coal-powered electricity and the petroleum industry will disappear.
- Other energy-intensive industries, such as mining and metal production, could lose out to less energy-intensive competitors where those exist. After 2040 there is likely to be no more demand for these products other than what countries judge to be sustainable in relation to their sink capacity.
- Renewable sources of energy become much more cost competitive than coal-fired electricity even at moderate PAP price levels.

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9 Appendix 1: Fossil Fuel Scarcity Rents

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. Under C&S 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

Production cost ($/barrel)	Oil price in USD per barrel	Producers' share of scarcity rent (Max)	Min rental captured by C&S from oil ($/barrel)	Producers' share of scarcity rent (Min)	Max rental captured by C&S from oil ($ /barrel)	Min. price per PAP in $	Max. price per PAP in $	Income range per person from selling 3.8 PAP, in $
30	60	100%	0	20%	24	0	53	0 - 203
30	100	90%	7	17.5%	57.75	16	128	59 - 488
30	150	80%	24	15%	102	53	227	203 - 861
30	200	70%	51	13%	147.9	113	329	431 - 1249
30	250	60%	88	11%	195.8	196	435	743 - 1653
30	300	50%	135	9%	245.7	300	546	1140 - 2075
30	350	40%	192	7%	297.6	427	661	1621 - 2513
30	400	30%	259	5%	351.5	576	781	2187 - 2968

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 is first introduced. Thereafter countries may realise that it may not be in their best

interest to engage in consumption and production patterns that require them to supplement their equitable sustainable per capita emission entitlement with purchases of scarce PAPs from outside their country . After a 9% cut every year, the *per capita* PAP entitlement will be quite small. If this assumption turns out to be sound, the value of each person's PAPs will never reach the highest figures in the table.

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

$$\frac{(2 \times 0.08) - (3 \times 0.02)}{0.06}$$ 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:

2010	30.95	billion	3.8	per person
2012	25.63	billion	3.12	per person
2015	19.31	billion	2.32	per person
2020	12	billion	1.43	per person

2025	7.52	billion	0.89	per person
2030	4.7	billion	0.55	per person
2035	2.9	billion	0.34	per person
2040	1.8	billion	0	per person

This is a 9% cut a year. This represents a total of 325.4 billion PAPs for the period 2010 to 2040 and may prevent temperature rises above 2^{o}C.