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SINKING THE CLIMATE:
WILL CANADA'S APPROACH
TO FORESTS AND LAND USE
SINK THE *KYOTO PROTOCOL*?

*Recently released data shows that, if
adopted, the Canadian position on the
treatment of forests and soils under
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WILL CANADA'S APPROACH TO CARBON SEQUESTRATION SINK THE *KYOTO PROTOCOL*?

In May 2000 West Coast Environmental Law released its report, *Torpedoing Kyoto: Will Canada's approach to Forest Sequestration Sink the Kyoto Protocol?* That report warned that Canada's unbalanced approach to counting forest sinks could only be corrected by crediting all carbon accumulation in forests and soils, and warned that this so-called "correction" would lead to a massive increase in industrialized countries' Kyoto emission limits.

As part of the process for negotiating the rules for forest accounting under the Kyoto Protocol, in August 2000, Canada and other countries were required to publish their official positions on how sinks should be counted under the *Kyoto Protocol*. Countries were also required to release data on how different forest accounting rules would effect them.

As feared, Canada took the position that industrialized nations should receive credit for accumulation of all carbon in forests, soils and wood products. Based on the recently released data, West Coast Environmental Law has calculated that if Canada's position is adopted, industrialized nations will be able to emit almost 12.5% more greenhouse gases into the atmosphere than would otherwise be allowed. This is significantly worse than WCEL had feared. Given that the *Kyoto Protocol* is only projected to reduce industrialized countries' emissions by twelve percent below business as usual trends, the Canadian approach could obliterate the environmental impact of the *Kyoto Protocol*.

As well as looking at the implications Canada's position on sinks has for global emissions of greenhouse gases, this paper recommends an alternative means of addressing the problems created by current provisions in the *Kyoto Protocol*. The paper recommends that parties only get credit for converting land to forest to the extent more land is converted to forest than deforested. The paper concludes that this approach is fair, preserves the environmental impact of the *Protocol*, and is consistent with the intent of the *Protocol*.

This paper is being release as nations of the world meet in Lyon, France to negotiate rules for the treatment of forest sinks.

EXECUTIVE SUMMARY

Carbon dioxide, the primary greenhouse gas, is released into the atmosphere from a variety of processes, including many related to land use and forestry. Land clearing, decay of debris after logging, forest fires, and natural plant respiration all release carbon dioxide. Carbon dioxide is also naturally removed from the atmosphere and stored or sequestered in forests and soils. Growing forests remove carbon dioxide from the atmosphere. Old growth forests both keep this carbon out of the atmosphere and in some cases continue to remove carbon dioxide from the air. Thus, protecting against deforestation and increasing the rate at which greenhouse gases are removed from the atmosphere and sequestered in forest or soil reservoirs is often promoted to mitigate climate change.

Under the *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (the “*Kyoto Protocol*”), developed nations are assigned amounts of allowable emissions (“assigned amounts”) for the period 2008 to 2012 (the “First Commitment Period”). These limits will potentially require significant reductions from current emission trends.

The emerging international regime for mitigating climate change provides some recognition of the role for sequestration. To meet their reduction obligations, nations are able to “credit” certain increases in their carbon sequestration levels and increase their assigned emission limits. Carbon credits for sequestration allow nations to increase greenhouse gas emissions from fuel combustion and industrial processes. Article 3.3 provides that a nation’s assigned amount of allowable emissions should be credited for any increase in sequestration in the period 2008 to 2012 due to afforestation or reforestation since 1990 and debited for deforestation since 1990. Article 3.4 provides a mechanism for adding other activities into the carbon accounting system.

Canada has proposed a comprehensive land based approach that includes all carbon sinks under Articles 3.3 and 3.4. Under such an approach Parties would receive credit for all verifiable changes in the carbon stock on agricultural or managed forestlands, measured from 2008 to 2012. Carbon stocks in wood products (houses, landfilled paper) would also be credited based on rules to be agreed by the Parties.

The main problem with the Canadian approach is that the forests of the world’s industrialized nations are a large net carbon sink. For the 2008 to 2012 time period almost all Annex B Parties project that, in the absence of any credit under the Kyoto Protocol, the total carbon stored in their forests and soils will increase, i.e. their forests and soils will be a net sink. Under the Canadian approach, Parties would receive credit for the entire increase in sequestration. This credit, generated by sequestration that will happen in any event, will allow more greenhouse gases to enter the atmosphere.

To calculate the effect of crediting business as usual sequestration, West Coast Environmental Law used recent submissions of Parties, past projections and past inventories to estimate the net sequestration credits Annex B Parties would receive if a the Canadian approach is adopted. Our estimates suggest that Annex B Parties’ net sequestration is equal to 12.5% of their assigned amount. **Adoption of the proposed Canadian approach would allow an over twelve percent increase in Annex B emissions over what is allowed in the absence of credit for sinks. This could obliterate any positive environmental impact from the *Kyoto Protocol*.**

Key Recommendations.

In the First Commitment Period:

- Limit the inclusion of sinks to emissions and removals related to changes in land use to or from forest uses.
- Provide credit for afforestation (i.e. converted to forest) based on the extent to which areas afforested exceed those deforested (i.e. converted from forest).
- Debit deforestation based on the extent to which areas deforested exceed those afforested.

INTRODUCTION

The *Kyoto Protocol* contains various provisions for crediting or debiting sequestration of greenhouse gases by the forests and soils of industrialized nations. The rules for this carbon accounting could have major impacts on the ease or difficulty of a country reaching its Kyoto commitment.

This paper examines current provisions for the crediting and debiting of sequestration under the *Kyoto Protocol*. It notes that these provisions are unbalanced.

It then looks at Canada's solution for correcting this imbalance. It finds that Canada's approach – counting all removals and emissions from forests and soils in a nation's emissions tally – would give industrialized countries carbon credits equal to 12.5% of their allowable emissions limit. These credits would allow countries to increase emissions from fossil fuel combustion without taking any additional action. This huge amount of credit was not taken into consideration in setting the emission limits under the *Kyoto Protocol*, and it is much greater than the credit that would be created under alternative approaches. It would virtually eliminate the need for any industrialized nations to take actions in reducing emissions.

As an alternative the paper recommends the approach promoted by the European Union. Under that approach nations would only be credited or debited for conversions of land to or from forest. Credits would only be given to the extent areas afforested exceed areas deforested. Debits would only be given to the extent areas deforested exceed the areas afforested. This approach is a practical solution to the problems created by the *Protocol*, and it does not defeat the purpose of the *Protocol*.

BACKGROUND

THE CARBON CYCLE

Carbon dioxide and other greenhouse gases are naturally released into the atmosphere from a variety of processes such as respiration by plants, decay of organic matter and forest fires. Natural forest growth and accumulation of carbon in soils normally balance these natural releases.

On the one hand, carbon is released into the atmosphere from forests, soils and wood products. This occurs through a variety of processes: natural respiration of plants; burning and decay of logging slash; decreases in carbon held in roots and soils following logging and land clearing; incineration of wood-waste; and the decay of wood products in landfills.

On the other hand, carbon is removed from the atmosphere by growing vegetation and sequestered in the wood, leaves and other tissue of plants. Once sequestered, carbon can move from one carbon reservoir to another. Carbon in leaves and branches becomes part of the forest litter and eventually soil reservoirs such as soils, forest litter, lumber, paper and other forest products.

Thus, both increasing the rate at which greenhouse gases are removed from the atmosphere and stored or sequestered in carbon "sinks" or decreasing the loss of carbon from forest and soil reservoirs are means of mitigating climate change. Overall scientists believe that the soils

and plants of the earth are a net sink, removing about 2600 megatonnes of carbon dioxide per year from the atmosphere.¹

THE KYOTO PROTOCOL & SINKS

In December 1997, negotiators from around the world successfully negotiated the *Kyoto Protocol to the United Nations Framework Convention on Climate Change* (the “*Kyoto Protocol*”). The *Kyoto Protocol* sets binding emission reduction commitments for those Parties – the developed nations – that are listed in Annex B of the *Protocol* (the “Annex B Parties”). Each Annex B Party is assigned an amount of allowable emissions (its “assigned amount”) for the period between 2008 and 2012 (the “First Commitment Period”). Canada is required to reduce its emissions by six percent below 1990 levels; the US by seven percent; European Union Parties by eight percent. The assigned amount is based on Parties’ gross emissions, i.e. emissions from burning fossil fuels and industrial processes, without accounting for removals by trees and soils.”²

Developed nations are able to “credit” certain increases in their carbon sequestration levels to meet their emission limits for the First Commitment Period. These credits are added to the nations’ assigned amounts, allowing an increase in actual emissions. Conversely, certain losses in carbon sequestration levels lead to carbon debits and will reduce a nation’s allowable emissions.

Article 3.3 provides that a nation will be credited (or debited) with any increase (or decrease) in sequestered carbon in the period 2008 to 2012 due to afforestation, reforestation, or deforestation, if these activities happened since 1990.³ Unfortunately, the terms “reforestation”, “afforestation” and “deforestation” are not defined in the actual text of the *Kyoto Protocol*. Afforestation and deforestation are recognized as meaning changes in land use. On the other hand, “reforestation” is often used to mean regeneration of trees after harvesting. However, the Intergovernmental Panel on Climate Change – the international community’s scientific advisors on climate change -- defines reforestation as “planting of forests on lands which have, historically, previously contained forests but which have been converted to some other use.” In turn, Article 5.2 of the *Kyoto Protocol* adopts the methodologies for estimating emissions and removals by sinks contained in *IPCC Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories* (the “1996 IPCC Guidelines”). The above definition comes from those guidelines.

Thus, Article 3.3 appears to mean that all conversions of land use to or from forests are counted. WCEL recommends the acceptance of this interpretation, in particular recommending adoption of the IPCC definition of reforestation.

Unfortunately, this interpretation (as well as all other interpretations) is “asymmetric”. A country with a long rotation period (i.e. a long time from a tree being planted until it reaches maturity) may receive a debit even if growth on areas reforested or afforested is equal to emissions from deforestation. Imagine a country in which one percent of the forest land base is deforested each year, and one percent is added to the forest base through reforestation or afforestation. Assume also that it takes 100 years for trees to reach maturity. Because removals from afforestation and reforestation occur slowly, while emissions from deforestation are almost immediate, one would need to count afforestation and reforestation for the last one hundred years to get an accurate picture of carbon emissions due to land use change.

In addition to Article 3.3, Article 3.4 provides a mechanism for adding other activities (beyond afforestation, deforestation and reforestation) into the carbon accounting system.

THE STATUS OF NEGOTIATIONS

Because Articles 3.3 and 3.4 leave many issues unresolved their interpretation and application is subject to continuing negotiation. In June 2000, Parties to the world climate treaty agreed to submit their positions on how the articles should be interpreted, and data on the impact various forest accounting rules would have. In August 2000, Canada, along with a number of other countries, submitted papers to the international climate secretariat on the interpretation of Articles 3.3 and 3.4, as well as data on sequestration. From September 4 to 15, 2000 all the Parties to the world climate treaty are meeting in Lyon, France to negotiate the application of Articles 3.3 and 3.4. A decision is expected at the world climate summit, scheduled for November 13 to 24, in the Hague.

THE CANADIAN POSITION: CREDIT FOR ALL NET SEQUESTRATION OF CARBON ON MANAGED FORESTS AND AGRICULTURAL LANDS.

Canada takes the position that all carbon sequestration not included under Article 3.3 should be included under Article 3.4 (the provision for adding new activities). Essentially, under Canada's approach allowable emission limits would continue to be based on gross emissions (emissions from fossil fuel combustion and industrial processes without accounting for removals by trees and soils), but compliance would be determined by looking at net emissions (gross emissions minus removals). This is sometimes referred to as the gross/net approach.

In many ways, Canada's position appears outwardly reasonable: all stocks of carbon are estimated on all lands subject to forest management or agricultural land management. Parties will receive credit for all verifiable changes in the carbon stock on these lands during the commitment period. In addition, carbon sequestered in wood products will be accounted for according to rules agreed to by the Parties. (Canada does not promote a particular approach to counting carbon in wood products.) All carbon pools (e.g. wood products, above ground biomass, forest litter, mineral soil carbon) must be counted unless there is evidence that they are not sources of greenhouse gases. Any future emissions from these carbon stocks will be accounted for in future commitment periods; thus, Parties must take responsibility for emissions caused by climate change itself (e.g. forest fires, infestations) or caused by nature. Areas converted from forest land or pasture and cropland must also be accounted for.

This redresses the imbalance created by 3.3, but what does it mean for the atmosphere?

ANALYSIS: WHAT DOES CANADA'S POSITION MEAN FOR THE CLIMATE?

The main problem with Canada's proposed approach is that:

- (a) Regardless of whether or not sequestration is credited, the forests of the world's industrialized nations (the Annex B Parties) are and will continue to be a large net carbon sink;

It is like an employer telling an employee they've been given a raise because on Monday their after-tax pay was \$750 per week, but on Tuesday their before tax pay was \$1000. What matters is the pay cheque, and that has not changed.



- (b) Crediting this activity will reduce the effectiveness of the Kyoto Protocol;
- (c) Credit for net removals from land use, land use change and forestry was not factored into the Kyoto target.
- (d) Credit for net removals from land use, land use change and forestry would negate the environmental effectiveness of the *Kyoto Protocol*.

a) Annex B forests and soils are a large carbon sink

For the 2008 to 2012 time period almost all parties are projecting that their land use change and forestry sector (the "LUCF" sector) will be a net sink. Table 1 attempts to estimate the credit from business as usual sequestration for all Annex B Parties. This Table uses newly released data from Parties' August submissions. The numbers in column three represent our best estimate of the credit Parties would receive under the Canadian approach.

The end result is a rough, but, we believe, conservative estimate. In particular, we believe it is conservative because often the data available for Parties excludes carbon stored in certain pools. In particular, many countries have not reported carbon stored in wood products or soil. Many countries' estimates are based on earlier compilations of data by the international climate secretariat of Parties projected net removals for 2010, or actual removals in 1990 to 1997. Typically, where Parties have supplied new information and projected removals based on use of a comprehensive approach like that advocated by Canada; their estimates of net sequestration have gone up. Canada's estimate of comprehensive sequestration doubled from earlier estimates. The US projection for 2010 was 400 megatonnes of sequestration per year, but in its August 2000 communication this was revised to over 1000 megatonnes per year. This suggests that many of the projections in Table 1 are, if anything, lower than what would occur using the Canadian comprehensive approach.

In total, Annex B Parties are projected to have net removals from land use, land use change and forestry equal to 10,834 Megatonnes for the first commitment period. This is equal to 12.5% of Annex B Parties Assigned amount. This is the total amount of credit Parties would receive under the Canadian approach.

In addition there is a risk that credit could be given for changes in carbon stock that are far greater than the 12.5% figure. For decades, scientists have been unable to account for between four thousand to eight thousand megatonnes of carbon being removed from the atmosphere yearly (20,000 to 40,000 mt. per five year commitment period), an amount equivalent to 28 to 56 percent of Annex B 1990 emissions.⁴ Scientists are increasingly suggesting that the missing sink is located in northern (Annex B) forests and wetlands. There is a risk that countries will take credit for this natural sequestration and use this credit to increase net emissions. It is currently impossible to separate natural sequestration from sequestration due to human management of forests. Thus, under Canada's approach countries may be able to take credit for this natural sequestration even if logging has reduced the rate of natural sequestration.

b) Crediting this sink will increase net emissions.

Under the Canadian approach Parties will receive credit for all of this sequestration. The sequestration is non-additional – i.e. it is business as usual activity that would occur with or without credit. This means that more emissions enter the earth's atmosphere. Parties will use credit from sequestration to allow more emissions from fossil fuels. In the absence of credit, the sequestration would still occur, but greater reductions in emissions would be necessary.

Actual emissions will rise because the sequestration is projected to occur for reasons unconnected to climate mitigation efforts. For instance, without credit for business as usual sequestration, the US must limit its emissions to 28,224 megatonnes over the five year commitment period from 2008 to 2012. With credit from non-additional activities, the US is allowed to emit 33,947 megatonnes of carbon dioxide – a twenty percent increase. Levels of sequestration remain the same.

c) Credit for this sink was not factored into the Kyoto Targets.

Large amounts of credit for non-additional activity is not inherently bad. It is only bad when it was not factored into the emission reduction targets agreed to in Kyoto. Under the Canadian approach, the emission target is set by reference to gross emissions⁵ (fossil fuel combustion and industrial emissions) but compliance is determined by net emissions (fossil fuel combustion and industrial emissions less removals from land use, land use change and forestry). This is like comparing apples and oranges. It is like an employer telling an employee they've been given a raise because on Monday their after taxes pay was \$750 per week, but on Tuesday their before tax pay was \$1000. What matters from the employee's perspective is the paycheck, and that has not changed. Similarly, what matters from the climate's perspective are net greenhouse gases entering the atmosphere. And, based on the estimates below, under the Canadian approach, that does not change.

It should be noted that other approaches to dealing with sinks only count sequestration in determining compliance with the Kyoto targets. However, under these other approaches, the impact on net emissions is much smaller, and in some cases the result of including sinks is to give countries a debit, requiring more emission reduction activity, not less.



TABLE 1			
Party	Estimated Assigned Amount (Mt CO ₂ eq.) ⁶	Estimated LULUCF Credit using Canadian Approach (Mt CO ₂ eq.)	Notes and Sources: ⁷ (see bottom of table for explanation of abbreviations)
Australia ⁸	2,644	40	CP
Austria	355	68.5	1997
Belgium	630	10	2010
Bulgaria	722	39	2010
Canada ⁹	2,817	192	CP
Czech	873	25	2010
Denmark	322	10	2010
Estonia	187	58	2010
Finland ¹⁰	346	40	CP
France ¹¹	2,547	171	CP
Germany ¹²	5,576	155	CP
Greece	495		NA
Hungary	478	15	1990
Iceland	14	0.96	CP
Ireland	246	48.5	2010
Italy	2,390	122.5	2010
Japan	5,770	279	2010
Latvia	164	69	2010
Liech	1.2	0.1	1990
Lithuania	237	38	2010
Luxembourg	62	1.5	2010
Monaco	0.5		NA
Netherlands	1,008	9	2010
NZ	365	106	2010
Norway	263	74	2010
Poland	2,652	203	1997
Portugal	294	6	1990
Romania	1,218	15	1990
Russia	15,200	2750	2010
Slovakia	351	40	2010
Slovenia	88	11	1990
Spain ¹³	1,418		NA
Sweden ¹⁴	325	83	CP
Switzerland ¹⁵	244	32	CP
Ukraine	4,596	354	2010
UK ¹⁶	3,522	45	CP
USA ¹⁷	28,224	5,723	CP
Totals:	86,645	10,834	

CP= based on Party's projection of comprehensive sequestration for the First Commitment Period¹⁸

2010 = based on projected net removals from the land use change and forestry for 2010.¹⁹

1997= based on Party's inventory of land use change and forestry removals for 1996 or 1997.²⁰

1990 = based on Party's inventory of land use change and forestry removals for 1990.²¹

NA = data not available

Estimated increase in GHG emissions relative to assigned amount is 12.5 %. This is likely a significant underestimate as most estimates do not include sequestration of carbon in wood products, and many

estimates do not include accumulation of carbon in soils. For those countries that provided data on the implications of the Canadian approach, the amount of credit grew substantially over estimates based on previous forecasts.

Table 2 compares the amount of credit Parties would receive under Article 3.3 as it is currently written (using the IPCC definition for reforestation), under the Canadian approach, and under the European Union's suggested approach (see further below). Under either the current Article 3.3 approach or the EU approach most countries receive only a fairly small debit or credit.²² On the other hand, they each receive a major credit if the Canadian approach is used.

d) Credit for net removals from land use, land use change and forestry would negate the environmental effectiveness of the *Kyoto Protocol*.

In total, actual or projected net removals from land use change and forestry from Annex B Parties are 12.5% of Parties' total assigned amount. If this is credited it amounts to a 12.5% percent increase in Annex B emissions over what is allowed in the absence of credit for sinks. For the reasons noted above, the figure could be considerably higher. Rather than reducing industrialized country emissions by five percent from 1990 levels, the Canadian approach allows emissions to climb by 7.5% above 1990 levels.

Country	Is country creating forests or deforesting?	Art. 3.3 (IPCC definition of reforestation) ²³	Canadian Approach ²⁴	EU Approach ²⁵
Canada	Net deforester: Area converted to forest is 3.2 percent of area deforested	-78.8	192	-76.3
Finland	Net deforester: Area converted to forest is 49 percent of area deforested	-5.1	40	1
Germany	Net afforester: Area converted to forest is 260 percent of area deforested	-1.2 ²⁶	155	2.4
Sweden	Net afforester: Area converted to forest is 102.9 percent of area deforested	-1.6	83	0.09
USA	Net deforester: Area converted to forest is 98 percent of area deforested	-25.7	5,723	3.3

Adoption of the Canadian position would obliterate most, if not all, of the *Kyoto Protocol's* environmental impact. The US Energy Information Agency projects that business as usual industrialized (Annex B) nations' greenhouse gas emissions in 2010 would be 8.99 % above 1990 levels, or 13.8% above the *Kyoto* emission limits.²⁷ The difference between the *Kyoto* assigned amounts and business as usual emission is 11,957 megatonnes of carbon dioxide equivalent.²⁸ However, Table 2 indicates that credit from sinks amounts to 10,834



megatonnes. In other words, the single loophole created by Canada's approach to sinks eliminates over 90% of the environmental improvement that the Kyoto Protocol is supposed to deliver.

A SOLUTION TO THE SINKS PROBLEM

As noted above, Article 3.3 creates a discrepancy: either credit or debits from afforestation and reforestation since 1990 cannot be fairly compared to debits from deforestation since 1990. There are numerous accounting approaches to Article 3.3, and reforestation can be defined as involving a land use change or as regeneration following logging. However, any combination of the above creates a discrepancy.

Canada proposed a "solution" to this. Unfortunately, the solution negates the environmental impact of the Kyoto Protocol.

Luckily, the EU has also suggested a solution. They have suggested that Parties receive:

- Credit for creating new forests on non-forested land, but only to the extent areas afforested are greater than areas de-forested.
- Debits for deforestation (i.e. converting land to non-forest use), but only to extent areas deforested are larger than areas afforested.

The single loophole created by Canada's approach to sinks eliminates over 90% of the environmental improvement that the Kyoto Protocol is supposed to deliver.

The limitation of the EU approach to activities involving changes in land use is consistent with the intent of the *Protocol*. However, to fix the imbalance created by Article 3.3, the EU suggests that Parties be allowed to adjust emissions from deforestation by not counting deforestation on areas where an equivalent area has been converted to forestry and has the same long term potential to sequester carbon. The EU approach is fair, and does not significantly impact on the significance of the Kyoto reductions. West Coast Environmental Law agrees with the solution proposed by the EU.

In addition, WCEL recommends that no new activities be added under Article 3.4 during the First Commitment Period. This is recommended because of the difficulty in setting baselines for measurement of carbon sequestration that do not dramatically impact the significance of Parties' climate commitments.

However, prior to the next commitment period the rules for carbon accounting can be determined, and their impacts estimated prior to the negotiation of targets.

Key Recommendations:

- **Interpret reforestation as "planting of forests on lands which have, historically, previously contained forests but which have been converted to some other use."**
- **Allow Parties to adjust emissions from deforestation by not counting deforestation on areas where an equivalent area has been converted to forestry and has the same long-term potential to sequester carbon.**

- **No additional activities should be added under Article 3.4 during the first commitment period.**
- **For second and subsequent commitment periods:**
 - **Methodologies for counting sequestration should be determined prior to negotiation of emission limits;**
 - **Expert reviewed projections of the net effect of agreed methodologies on each Annex B Party should be available to all Parties in advance of emission limit negotiations.**



ENDNOTES

- ¹ Bert Bolin and Raman Sukumar “Global Perspective” in Intergovernmental Panel on Climate Change, *Land Use, Land Use Change and Forestry*, (Cambridge: Cambridge University Press, 2000), page 32. Carbon converted to carbon dioxide by multiplying by 44/12.
- ² An exception exists under Article 3.7 for countries whose forests and soils were sources in 1990. This is limited to Australian and the United Kingdom.
- ³ COP 5 clarified the obtuse language of Article 3.3, agreeing that 3.3 meant: “The adjustment to a Party’s assigned amount shall be equal to verifiable changes in carbon stocks during the period 2008 to 2012 resulting from direct human induced activities of afforestation, reforestation and deforestation since 1 January 1990. Where the result of this calculation is a net sink, this value shall be added to the party’s assigned amount. Where the result of this calculation is a net emission, this value shall be subtracted from the party’s assigned amount.” FCCC/CP/1998/L.5. C
- ⁴ Jocelyn Kaiser, “Possibly Vast Greenhouse Gas Sponge Ignites Controversy” (16 October 1998) v. 282 *Science* p. 386.
- ⁵ See note 2.
- ⁶ Assigned amounts from Climate Secretariat document FCCC/SBSTA/2000/INF.7.
- ⁷ Data has been used in the following order of preference (1) commitment period projections from August 2000, where comprehensive data has been provided; (2) 2010 projections dated 1998 and multiplied by five; (3) Parties’ 1997 inventory for LUCF net emissions and removals, multiplied by 5; (4) Parties’ 1990 inventory for LUCF net emissions and removals, multiplied by 5.
- ⁸ Reforestation, afforestation and deforestation activities have been excluded from Australia’s estimate. This is because inclusion of these activities was the basis for an adjustment to Australia’s assigned amount under Article 3.7. (Australia and the UK are exceptions to the general rule that sinks were not factored into Parties assigned amount). The Canadian approach would allow Australia and the UK to receive additional credit for sinks equal to the amount given in Table 1.
- ⁹ The figure is the total of the Canadian projection for sequestration from forest management, the central projection for crop management and low projections for grazing land management and shelterbelts. Based on Canada’s submission, these projections appear to represent business as usual. Sequestration in forest products is also included, extrapolating the latest available data (1996) on forest product sequestration to the commitment period. Sequestration in forest products is estimated to be 8 Mt per annum based on the differential between IPCC default method and estimates using stock change method as shown in. P. Collas, *Canada’s Greenhouse Gas Inventory, 1997 Emissions and Removals with Trends* (Ottawa: Environment Canada, 1999) page 58. The total is reduced by projection of emissions from deforestation.

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- ¹⁰ Finnish estimates include only woody mass and exclude wood products.
- ¹¹ French estimates exclude agricultural soils. Figure is based on French estimates for enhancement of carbon sink in wood products and the reference case for contribution of French forests to sequestration. French sequestration estimates for forest management are assumed to include deforestation and have not been adjusted downward by estimated deforestation. The accounting basis for the French estimates was at times unclear. As a reality check the French estimate was compared to previously projected 2010 net LUCF removals of 65 mt per year (325 Mt per commitment Period) and 1997 removals of 67 Mt per annum (335 Mt per CP). Thus the figure used appears very conservative.
- ¹² German estimate excludes forest and agricultural soils and wood products. Not clear whether 3.3 activities included in German estimate; however, figure used is consistent with previous estimates of net German removals from land use change and forestry.
- ¹³ Spain's projections for activities under 3.4 were not used as they do not indicate which activities are included.
- ¹⁴ Swedish estimates for above and below ground biomass only. Includes forest management and forest conservation, adjusted for afforestation and deforestation. Total figure appears to be conservative and is lower than previous Swedish projections for net removals from the LUCF sector (Those projections were for 22 Mt per year or 110 Mt over the entire commitment period)
- ¹⁵ Swiss estimates for establishment of forest reserves, cropland management, cropland conversion and grassland management.
- ¹⁶ UK estimates are the UK projection for forest management only. They have not been adjusted for afforestation and deforestation for the same reasons as discussed with regard to Australia.
- ¹⁷ US estimate from August 1 Submission. Estimate includes forest management, cropland management, grazing land management, and wood products sequestration on carbon stock basis.
- ¹⁸ Projections for Commitment Period from projections by the Parties dated August 2000 for the Commitment Period, compiled in FCCC/SBSTA/2000/Misc.6 and FCCC/SBSTA/2000/Misc.6, Add. 1. Where necessary conversions from carbon to carbon dioxide have been made by multiplying by 44/12.
- ¹⁹ 2010 indicates projections for 2010 are for net emissions or removals from land use change and forestry contained in FCCC/CP/1998/11/Add.2, Table C.2.
- ²⁰ 1997 or 1990 indicates the data is from National inventories contained in FCCC/SBI/1999/12, Table B.7.
- ²¹ 1997 or 1990 indicates the data is from National inventories contained in FCCC/SBI/1999/12.



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- ²² Canada is an exception because we are a net de-forester: we deforest large areas for urban development, gas and oil pipelines, agriculture, highways and logging roads. In comparison we only re-establish forests on a very small amount of land each year.
- ²³ Data from Table 1 of Parties August 2000 Submissions to climate secretariat. Projected change in carbon stock for commitment period from afforestation and reforestation using IPCC definitions, plus change in stock from deforestation for Commitment Period. Measurements in carbon converted to CO₂ by multiplying by 44/12. Midrange or average values used where countries project range of values.
- ²⁴ Data from Table 1 of this Report. See footnotes to Table 1 for calculation methodologies.
- ²⁵ Data from Table 1 of Parties August 2000 Submissions to climate secretariat. For countries in which area converted to forest (i.e. afforested or reforested) exceeds area deforested, figure is equal to estimated change in carbon stock for the commitment period due to afforestation multiplied by (Area afforested period – area deforested/ area afforested). Converted to CO₂ by multiplying by 44/12. For countries in which area converted to forest (i.e. afforested or reforested) is less than area deforested, figure is equal to estimated change in carbon stock for the commitment period due to deforestation multiplied by (Area deforested – area afforested/ area deforested). Converted to CO₂ by multiplying by 44/12. For all countries except Sweden and Finland areas used are projections for areas deforested or afforested during the commitment period. For Sweden and Finland projections for commitment period based on projections for entire period 1990 to 2012. Midrange or average values used where countries project range of values.
- ²⁶ Only above ground carbon counted.
- ²⁷ US Energy Information Agency, *International Energy Outlook, 2000*. (March 2000) page 162. The US EIA projections are for carbon only. However it is conservative to extend this to all greenhouse gases as carbon dioxide accounts for 80% of the total Kyoto gases, and emissions of the next most significant Kyoto gas – methane are generally projected to decline for Annex B countries.
- ²⁸ This is based on multiplying the 13.8% by the total assigned amount contained in Table 1.