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EcoSecurities carbon accounting calculator: Comparing methodologies for addressing non-permanence

Sandra Brown
Winrock International
1611 N Kent St, Suite 600
Arlington, VA 22209

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Louise Aukland and Pedro Moura Costa

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1. Introduction

One of the main concerns related to the use of sinks as a greenhouse gas (GHG) mitigation option is the question of ‘permanence’, the length of time for which carbon will remain stored after having been fixed in vegetation. In reality, the concern is about lack of permanence, ‘non-permanence’ or ‘reversibility’ of the benefits of storage, as a result of the possible loss of carbon stocks created or conserved by a project, whether on purpose (e.g. timber harvests) or as a result of undesirable events (e.g., natural disasters). Permanence is the main technical issue that differentiates forestry-based GHG mitigation projects from emission reduction projects.

This report is the sequel to the review undertaken by EcoSecurities of methodologies relating to the issue of permanence for land use, land use change and forestry (LULUCF) projects. It describes the EcoSecurities carbon accounting calculator, an Excel-based tool that can be used to analyse the effects of different approaches for dealing with permanence and duration on carbon credit flows and financial feasibility of projects. The report will include a description of the model and a comparison of methodologies using a demonstration project. It will then go on to look at a number of existing projects and the impact of different accounting methodologies on their carbon credit flows and carbon finance.

2. The EcoSecurities carbon accounting calculator

The EcoSecurities carbon accounting calculator is an Excel-based spreadsheet model that enables users to:

a) Compare different methodologies for accounting for non-permanence using a demonstration project;
b) Analyse the impact of different accounting methodologies on project specific data, in particular focusing on projections of carbon offsets and cash flow.

The calculator consists of the following spreadsheets:

- **Introduction** – providing instructions on how to use the calculator;
- **Input and Results** – the user chooses the relevant project and adjusts the carbon accounting factors such as crediting periods, verification dates, discount rates, and equivalence factors, and sees the results;
- **Financial Analysis** – a breakdown of price, Net Present Value (NPV) and financial projections using the different accounting methodologies;
- **Credit Projections** – projections of yearly and cumulative credit flows according to different methodologies;
- **Project Data** – input sheet for project specific data and explanation of demonstration project parameters.

The following sections will explore in more detail how each spreadsheet functions and describes the methodologies that are compared in the calculator.

2.1. Accounting methodologies

Four accounting methodologies are compared, namely the stock change, average storage, temporary crediting and ton-year. As was noted in the first report, there are a number of variables that define any one accounting methodology (see previous report). For the purpose of the comparison generated by the EcoSecurities carbon accounting calculator, the following variations are applied:

1) **Stock change –** Credits accrue and are cancelled on an annual basis, as and when fluxes in net carbon storage occur. Credits stop accruing either at the end of the project (specified by the user), or, according to the crediting period e.g. 21-years. In either case, the project remains responsible for the re-emission of carbon credits forever, i.e., whenever a re-emission occurs.
2) **Average storage –** Credits are accrued annually up to, and not exceeding, the average storage. The timeframe over which the average storage is calculated is either fixed at 100 years, or is variable and indicated by the project duration.
3) **Temporary credits or T-CERs –** credits are assumed to be temporary and to 'expire' after a certain period of time. Although there are a number of proposed 'lifetimes' for temporary credits, the model assumes a fixed period of 5 years and is based on EcoSecurities understanding of the EU proposal (see attached). However, the following variations are available:
    a) the T-CER proposal with a limited crediting period, e.g. 21 years (using stock change)[1];
    b) T-CERs not limited to any crediting period, but limited to project lifetime (using stock change);
    c) T-CERs limited to a crediting period, e.g. 21-year, but calculated according to the average storage over every 5-year commitment period.
4) **Ton years** – credits are awarded to reflect the temporal dimension of carbon storage and are calculated either till the end of the project or on a crediting period regime, e.g. 21-years. The equivalence factor used to calculate credits can be adjusted by the user, but this paper will adopt the factors proposed in Moura-Costa and Wilson (2000) (i.e., a time for reaching equivalence of 55 years).

2.2. Input and results

The 'Input and Results' sheet provides the user with most of the information needed to compare the methodologies, including a summary of the outputs from the other spreadsheets. Table 1 summarises the information that the user can specify on this sheet, and the results that are given. This is where the user specifies the project to be simulated, by inputting the project number, which in turn links into the respective data on the 'Project Data' sheet, and project start date.

The calculator is also fitted with a demonstration project (Project 1) that enables the user to observe different project scenarios, in terms of carbon stocks per hectare over time, the impact of carbon accounting methodologies on credits awarded, and net present value (NPV). The user is able to define the carbon dynamics of the demonstration project by specifying the project duration (years), rotation period (years) and maximum carbon storage per hectare (tC/ha), thereby projects with

[1] Note that it is recognized in the EU proposal that a 21-year (or less) crediting period is not appropriate for LULUCF projects.

different carbon profiles can be simulated. The projections of carbon stocks, for both the demonstration project and the actual projects, are detailed on the 'Project Data' sheet.

The user is also able to specify a number of carbon accounting factors that relate to the different methodologies:

- In the case of the T-CER method, the initial verification date will be used as the date of credit issuance. It is assumed that verification will occur every 5-years following this date and that the credits are only valid for a 5-year period. This will therefore fit in with the EU proposal for temporary crediting, with verification taking place once during each commitment period.
- The crediting period relates to the period over which a project can be awarded credits and is presently a maximum of 21 years for CDM projects (following provisions in the Marrakech Accords[2]). It has been recognised that this 21-year crediting period may not be used for land use projects (see EU proposal to the UNFCCC FCCC/SBSTA/2002/Misc.22), and this input allows the user to observe the impact of lengthening the crediting period on the outputs.
- The discount rate is used to calculate the net present values of the respective credits and can be varied on the 'inputs and results' sheet. These are calculated using the price for a permanent emission reduction and a price escalator, both of which can also be specified on this sheet by the user. For more information on the financial analyses undertaken by the calculator, refer to the 'financial analysis' explanation below.
- The final input, the 'equivalence factor' relates only to the ton-year method of accounting. A number of proposed equivalence factors exist (see previous report for discussion) and these can be inputted here depending on the preference of the user (the results in this report were based on a 55-year equivalence factor).

The results section of the 'inputs and results' sheet displays the outputs of the analysis in terms of credits accrued, credits returned, the relative prices and NPV for the different accounting methodologies. The credit flows are also displayed graphically to provide a visual comparison of the methods and the impact of changing the different calculator variables. Further information on how these outputs are calculated is given below.

Table 1: Information specified and outputs given on the 'Inputs and results' sheet.

Inputs Specified by user	**Cell number**	**Outputs** Given by the calculator	**Cell number**
Project being simulated	C4	Project name	B5
Project start date (only from 2000)	C7	Project duration (years)	C6
Demonstration project inputs	G5-G7	Credits accrued (tC)	C23-C35
Initial verification date (year)	C12	Credits returned (tC)	D24-D35
Crediting period (years)	C13	Net Present Value (NPV)	E24-E35
Discount rate/opportunity cost (%)	C14	Relative prices (U$/tC)	F24-F34
Carbon price for permanent CER ($/tC)	C15	Graphic display of credit flows for different methodologies	N/A
Price escalator (%)	C16		
Equivalence factor	C18		

[2] Projects must choose either a maximum period of 10-years with no renewal or 7 years with two possible renewals, each of 7 years. Therefore a maximum of 21-years is used throughout this analysis and report.

2.3. Financial analysis

The financial analysis sheet contains the calculation of relative credit price, future projections of price and calculation of Net Present Value for each of the methods.

The calculation of price was based on the relative value of sinks credits in relation to a fully permanent (i.e., without any risk of re-emission) CER from an emission reduction project. To enable a comparison of the T-CER and other carbon accounting units, the financial projections assumed that credits were sold using "buyer liability" agreements (the implicit assumption behind the T-CER method). This means that the credits are sold by the seller at a discounted price, which reflects the relative value of liabilities (i.e., from planned re-emissions) in relation to the total amount of credits sold. At the same time, the seller is not penalised when there are re-emissions. The relative price of credits accounted for using each of the methodologies was based on the existing price for a full emission reduction minus the present value of any future liabilities (i.e., those associated with stock re-emissions), minus 1 US$ cent. The 1 US$ cent is subtracted to generate a price advantage for purchasing LULUCF credits (with liabilities) over the purchase of permanent emission reductions today. The credit prices using different methodologies were calculated according to the following:

- **Stock change with no limit** – credit value was calculated based on the existing price for a full emission reduction, minus the present value of any future liabilities, minus 1 US cent. Credits are accrued up till end of project duration, with liabilities due to planned re-emissions accounted for as and when they occur.
- **Stock change with limited crediting (e.g. based on the 21-year crediting period)** – the credit value is calculated as the relative value of the carbon credits today versus the value of the liability today, compared to the value of a permanent emission reduction today, minus 1 US cent. Liabilities are calculated as and when emissions occur, but credits only accrue for a limited crediting period (e.g. up to year 21).
- **Average storage with fixed denominator (i.e., 100 years)** – the credit value is calculated by proportionally deducting the present value of the liabilities associated with re-emissions at year 100, from the value of a permanent emission reduction today, minus 1 US cent. Given that the value of any liabilities in 100 years is very small; the credit value is very close to the price of a full emission reduction.
- **Average storage with variable denominator** – this is calculated in a similar way as above, except that the final re-emission is assumed to occur in the final year of the project (irrespective of whether the carbon stocks will be maintained for a longer time). The final year of the project is based on project duration (C6), which can be specified by the user for the demonstration project in cell G5. To simulate a 21-year crediting period, the project duration can be set at 21 years.
- **T-CERs** – their value was calculated as the difference between the value of a permanent emission reduction today, and its value in 5 years (i.e., the present value of a permanent emission reduction purchased in 5 years), minus 1 US cent.
- **Ton-years** – the use of this method is based on the assumption that there will not be any liabilities associated with re-emissions; therefore its price is equal to the full emission reduction unit.

When using the calculator, a number of factors can be altered on the 'Input and Results' sheet that affect the financial analysis, namely the initial price of permanent emission reductions, the price escalator and the discount rate or opportunity cost (to illustrate time preference related to the purchase of T-CERs). This is to allow more flexibility in the future projections of credit prices and therefore enable the user to observe the sensitivity of the methodologies to changing markets. These factors will influence the outputs of credit price and net present value. Full workings can be seen on the 'Financial Analysis' sheet, but the results are also given on the 'Input and Results' sheet.

2.4. Credit projections

The 'Credit Projections' sheet contains the calculations and yearly projections of credit flows according to the different methodologies and does not therefore require any inputs from the user. The sheet sources its information from other parts of the calculator, in particular the 'Project Data' sheet. The cumulative credits are projected annually for the 100-year period of the calculator, according to the schedule outlined for the different methods (section 2.1). Although outputs are given on this sheet, in yellow cells, they are the same outputs that are given on the 'Input and Results' sheet, so it is not necessary to see them here.

2.5. Project data

This final sheet is used to input the project specific data as projections of carbon stocks per hectare per year, and project duration. The projections are given as net carbon benefits, i.e. project carbon – baseline carbon. The dynamics of the demonstration project are defined by the user on the 'Input and Results' sheet, but are displayed here as volume at rotation or maximum volume (tC/ha) and annual growth rate (tC/ha/yr).

Although many projects calculate net carbon benefits across a number of hectares, observing the results on a per hectare basis enables the effects of carbon fluxes to be compared more effectively. It is also essential that any accounting methodology is able to cope with periodic negative fluxes in carbon storage. In some cases, averaging across a number of hectares may well soften out the fluxes observed in forest systems where harvesting is occurring, but there may still be periods of negative flux that need to be accounted for e.g. the Romania project. However, carbon stocks can be input into the model as project wide totals (not per hectare) and the calculator will still function. If the user wishes to do this though, they ought to interpret 'per hectare' labels as 'per project'.

Five projects are profiled on the sheet and given a number (column A). It is this number that the user specifies on the 'Input and Results' sheet (cell C4) to choose which project is being simulated. The 5 project options are:

1. the demonstration project – parameters defined by the user;
2. the Guaraquecaba project – a combined avoided deforestation and forest rehabilitation project in the Atlantic forest region of Brazil (30-year project duration);
3. the Noel Kempff Climate Action Project – an avoided deforestation and stop-logging project in Bolivia (30-year project duration);
4. the Rio Bravo Project – an avoided deforestation and stop-logging project in Belize (40-year project duration);
5. the Romania Project – an afforestation project in Romania (30-year project duration).

Note that each of the projects has a specified duration. In reality, the forest will remain in place, and continue to store the credited carbon, beyond the specified project duration. However, to enable comparison between methods, liability must be assumed at the end of project duration irrespective of whether or not the forest will continue to store carbon beyond the project duration.

Section 3 of this report will investigate the impact of the different accounting methodologies on outputs from the demonstration project, using different project scenarios (e.g. rotation length and maximum carbon storage). Section 4 will investigate further the actual case studies (projects 2-5) and the implications of the carbon accounting methodologies.

3. Comparison of methodologies

This section will explore and compare the outputs of the different proposals for dealing with non-permanence of LULUCF projects, using the demonstration project to illustrate the differences. For a full explanation of the different proposals, refer to the first report called ‘Review of methodologies relating to the issue of permanence for LULUCF projects’ and Section 2.1 above. The description of the EU proposal that was used as a basis for the T-CER method is also attached to this report, for information.

The demonstration project can be defined by the model user on sheet ‘Input and Results’ in cells G5, G6 and G7, therefore altering the project duration, rotation length (if including harvests) and maximum carbon storage (tC/ha). By adjusting the rotation length and maximum storage, it is possible to influence the annual growth rate, which is displayed on the ‘Project Data’ sheet. If the user wants to simulate a forest regeneration project that does not involve any harvesting or planned reemissions, then simply set the rotation period (‘Inputs and Results’ G6) at the same length, or longer than, the project duration (‘Inputs and Results’ G5). Note that the calculator always assumes full liability (full re-emission) at the end of project duration, irrespective of whether carbon stocks are maintained beyond the project’s end.

In the following sections, a number of different project scenarios are run and the results compared to demonstrate the relative advantages and problems associated with the different methodologies. Table 2 describes some of the scenarios that may be referred to in this analysis, which will enable a comparison of the impact of changing rotation length and project duration. Unless otherwise stated, all the scenarios assume a price of U$10 /tC for a permanent emission reduction credit, no price escalator and a discount rate of 10%. Initially, the analysis focuses on the factors and variables that overlay any accounting methodology, following by a more specific analysis of the temporary crediting proposals.

Table 2: Project scenarios (Maximum storage fixed at 120 tC/ha):

Scenarios	*Project duration (yrs)*	*Rotation (yrs)*
A	50	15
B	50	40
C	100	15
D	100	40
E	50	7

3.1. The fixed crediting period – e.g. 21-year crediting

As mentioned earlier, and in the previous report, the existing crediting period for CDM projects is a maximum of 21 years (3 x 7 years). The ongoing discussions relating to LULUCF projects, in particular the modalities for inclusion of these activities under the CDM, have questioned the relevance of using the same crediting period as for non-LULUCF projects. It is becoming more widely acknowledged that an alternative system may need to be adopted for the land use sector. As it stands at present with a limited crediting period, the following points are of concern:

- Setting a limit on the crediting period does not fit in with the biological nature of land use systems, and can result in arbitrary accounting and over, or under, crediting of projects.
- What happens if re-emissions occur following the end of the crediting period?

The first point is particularly well illustrated for projects establishing relatively slow growing species, where stopping crediting at 21 years would be early in the growth phase, therefore resulting in very few credits being awarded when compared to faster growing species. This is clearly incompatible with the long-term nature of LULUCF projects and would incentivise the choice of fast growing (often exotic) tree species. This effect would be observed for any of the accounting methodologies.

Table 3: Credits accrued over a 21-year crediting period for varying rotation lengths, using the stock change method of accounting (maximum storage fixed at 120 tC/ha, project duration fixed at 50 years).

Rotation length (yr)	Credits accrued over 21 years (tC)	Maximum storage potential (tC/ha)	% of maximum storage actually credited (%)	Net credits in year 21 (tC/ha)	Growth rate (tC/ha/yr)	Observations
7	326	120	+100	120	17.14	**NB**: Given that Maximum storage is fixed, the growth rate will decrease with increasing rotation length. It has been included here just for information. • short rotations receive more credits overall than longer rotations, as a result of faster growth rates; • the cut off point of 21-years results in an arbitrary and unfair allocation of net benefits at the end of the 21-year period; • species with rotation lengths longer than the crediting period will never be rewarded for the maximum storage for that species.
8	285	120	+100	75	15.00	
9	253	120	+100	40	13.33	
10	228	120	+100	12	12.00	
11	218	120	+100	109	10.91	
12	200	120	+100	90	10.00	
13	185	120	+100	74	9.23	
14	171	120	+100	60	8.57	
15	160	120	+100	48	8.00	
16	150	120	+100	38	7.50	
17	141	120	+100	28	7.06	
18	133	120	+100	20	6.67	
19	126	120	+100	13	6.32	
20	120	120	100	6	6.00	
21	120	120	100	120	5.71	
22	115	120	96	115	5.45	
23	110	120	92	110	5.22	
24	105	120	88	105	5.00	
25	101	120	84	101	4.80	
26	97	120	81	97	4.62	
27	93	120	78	93	4.44	
28	90	120	75	90	4.29	
29	87	120	73	87	4.14	
30	84	120	70	84	4.00	
40	63	120	53	63	3.00	
50	50	120	42	50	2.40	
60	42	120	35	42	2.00	

For stock change-based accounting methods using the 21-year crediting period, or indeed any fixed crediting period, the amount of credits that a project accrues is a function of cutting cycle timings and growth rates. This is illustrated in Table 3, which shows the amount of credits accrued during the 21 years for plantings established in year 2000 but with different cutting cycles or rotations. Note that the total number of credits accrued is higher for shorter rotations. Once the rotation is longer than 21 years, maximum storage is never rewarded (as mentioned above). Thus, limiting the crediting period is inappropriate for slow growing species and can lead to unfair crediting of species with rotations of less than 21-years, due to arbitrary cut off points.

The average storage approach simplifies the crediting and debiting system when compared to the stock change system of accounting and therefore avoids some of the problems encountered with a fixed crediting period. However, it is still inappropriate for those forest systems or species with slow growth rates, because the 21-year cut off point may be reached before the average storage, resulting in under-crediting compared with fast growing systems. It is also unclear whether or not the 21-year period would be related to the denominator for calculating the average storage, or whether another figure should be specified in the event that a limited crediting period is adopted.

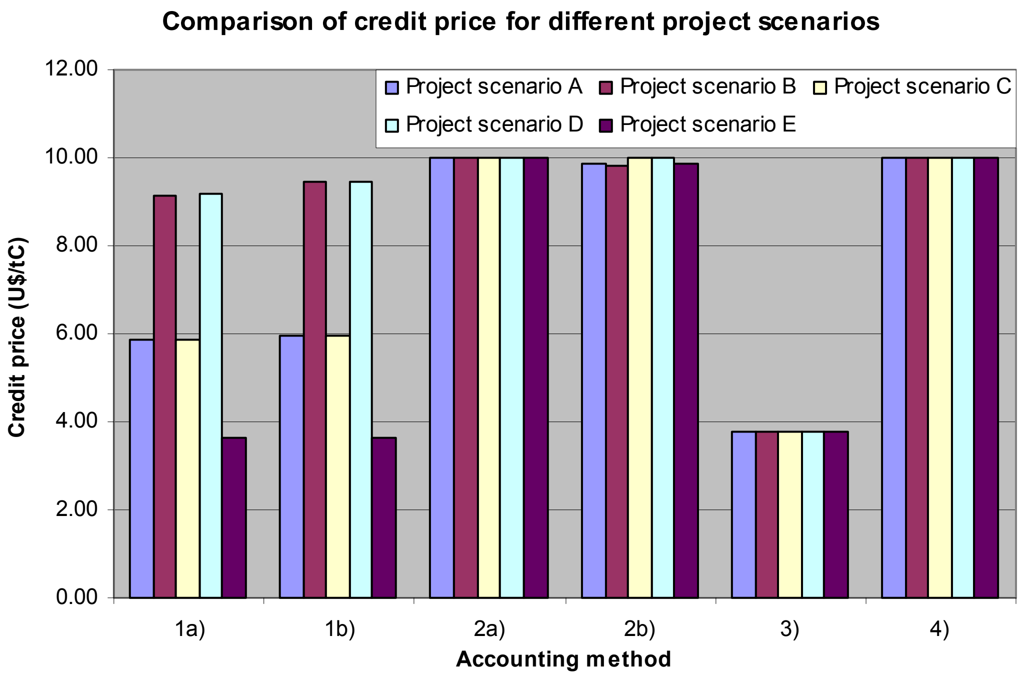
3.2. Financial aspects

On the ‘Input and Results’ sheet there is the opportunity to vary the factors used in the financial analysis. Table 4 compares the credit price and net present value of the carbon benefits for the different methodologies, applied to Project Scenario A. As a result of the 5-yearly liabilities associated with the temporary crediting system, the credit price for this method is much lower than for the other approaches. The average storage methods have credit values that are close to the value of a permanent emission reduction because they only have liabilities at the end of the project. Because the ton-year does not have any liability associated with re-emissions, it is assumed to be equivalent to a full emission reduction and therefore has the same price, but the NPV associated with this method is always much lower than the others because of the time delay in crediting compared with other methods. The comparison in Table 4 is made for just one project scenario with project duration of 50 years and rotation length of 15 years. Figures 1 and 2 compare the NPV and relative credit price for the whole range of project scenarios A-E.

Table 4: Comparison of credit price and NPV, assuming 10% discount rate and CER price of US$10 tC. For further information on how price was calculated for each method, see section 2.3.

Methodology	Credit price (U$/tC)	Net present value (U$/ha)
1a) Stock change – till end of project	5.85	409
1b) Stock change – till end of crediting period (21 yrs)	5.96	384
2a) Average storage, fixed denominator	9.99	216
2b) Average storage, variable denominator	9.86	366
3a) T-CERs with limited crediting (21 yrs)	3.78	246
3b) T-CERs till end of project	3.78	287
3c) T-CERs with limited crediting (21 yrs) and average storage	3.78	255
4a) Ton-years till end of project	10.00	82
4b) Ton-years with limited crediting (21 yrs).	10.00	72

Figure 1:

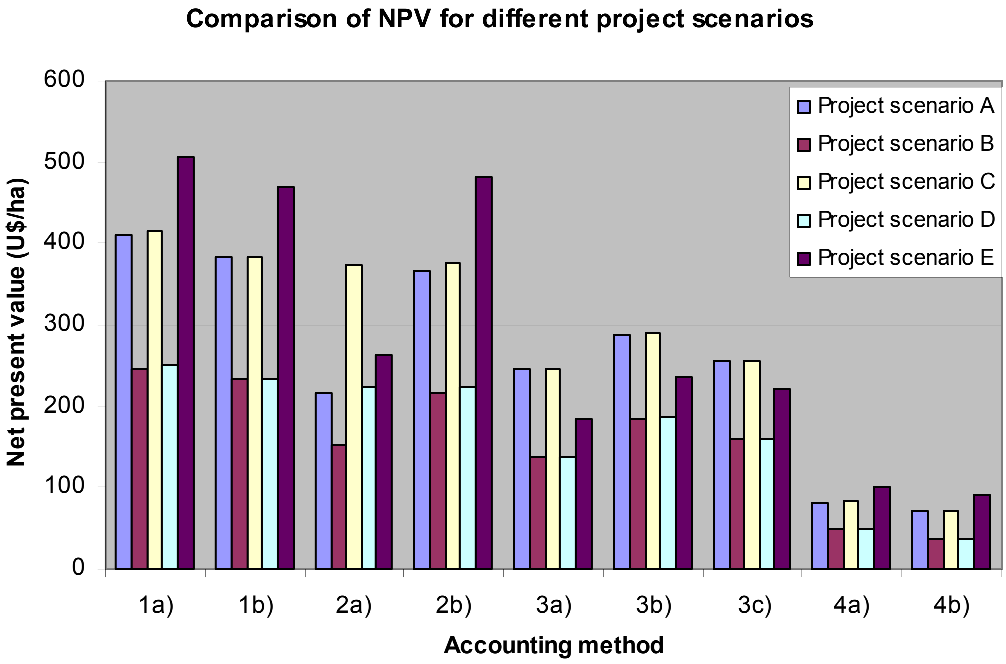


As shown above, the credit price only varies considerably across different Project Scenarios (project duration and rotation length) if quantified using the stock change accounting method. This reflects the impact of time on the liabilities linked to cutting cycle or rotation length. For example, Project Scenario E, with a very short cutting cycle of 7 years has liabilities early on in the project lifetime and a low credit price as a result. In comparison, project scenarios B and D have 40-year rotation lengths and a correspondingly high credit value. There is only a very subtle difference between B and D, when stock change is calculated till the end of the project (method 1a), which reflects the difference in project duration of 50 and 100 years respectively. It is clear that the cutting cycle or rotation length is the most important factor in determining credit price for the stock change approach.

In comparison, the credit price for average storage approaches is consistently close to a full emission reduction credit price even for variable cutting cycle and project duration. This is also true for the temporary crediting methods, although the credit price is low, to reflect the liabilities linked to 5-year credit issuing, retiring and replacement. Only when the rotation length is very short, e.g. project scenario E, do any of the other methods result in credit prices similar to those of temporary credits, and then only for stock change approaches.

A comparison of net present values for the different project scenarios shows much more variety across and between the accounting methodologies (Figure 2). The overall trend of decreasing NPV from the stock change methods (highest), through average storage, temporary crediting and finally to ton-year (lowest) is well illustrated in the figure. There is also a clear division between those projects with relatively short rotation lengths (A and C at 15 years, and E at 7 years) when compared to longer rotation lengths (B and D at 40 years). The former have much higher NPV than the latter.

Figure 2:



Although it is interesting compare the methods according to different project scenarios, it is also worth remembering that the financial factors have been kept static in these analyses. It is possible to change the financial inputs used in the calculations, notably the discount rate and price calculator. These are investigated further below. The impact of altering the initial price of permanent emission reductions will have no effect other than to increase or decrease the relative price of non-permanent credits according to the patterns described above.

3.2.1. The impact of changing discount rates

The analyses undertaken so far in this report are based on a fixed discount rate of 10%. The impact of time is particularly important for projects with regular carbon fluxes, which occur as a result of thinnings or periodic harvests. The value of the liabilities associated with re-emissions will be highly sensitive to increases or decreases in discount rates. Table 6 presents the results of varying the discount rate on both the credit price and net present value for Project Scenario A. As a result of the liabilities at the end of the project duration, the price of LULUCF credits is greatly influenced by discount rates. At low discount rates, the price for LULUCF credits is, in general, also low. This is because future liabilities will have a high value associated with them, therefore limiting the benefits of postponing emissions until the future. Conversely, with high discount rates, the value of future liabilities associated with LULUCF credits is low, and hence the credit value is high. This does mean that the NPV will be lower at higher discount rates. For methodologies that include regular liabilities, such as the T-CER approach, or those that reflect re-emissions as they occur, like the stock change approach, the impact of high or low discount rates can be considerable.

Table 6: Comparison of credit price and NPV, with variable discount rate (Project Scenario A permanent emission reduction price at 10 U$/tC and no price escalator).

	Discount rate 5%		**Discount rate 15%**		**Discount rate 20%**	
Methodology	Credit price (U$/tC)	NPV (U$/ha)	Credit price (U$/tC)	NPV (U$/ha)	Credit price (U$/tC)	NPV (U$/ha)
1a) Stock change – till end of project	3.47	461	7.38	336	8.35	275
1b) Stock change – till end of crediting period (21 yrs)	3.67	381	7.43	329	8.37	273
2a) Average storage, fixed denominator	9.90	250	9.99	187	9.99	163
2b) Average storage, variable denominator	8.92	416	9.97	300	9.99	248
3a) T-CERs with limited crediting (21 yrs)	2.15	265	5.02	185	5.97	132
3b) T-CERs till end of project	2.15	381	5.02	197	5.97	136
3c) T-CERs with limited crediting (21 yrs) and average storage	2.15	277	5.02	193	5.97	140
4a) Ton-years till end of project	10.00	177	10.00	47	10.00	30
4b) Ton-years with limited crediting (21 yrs).	10.00	128	10.00	45	10.00	29

3.2.2. The impact of variations in future prices

Market prices for carbon credits may well rise or fall in the future depending on supply and demand. The price escalator can be used to simulate changing prices of carbon in the future, based on an annual percentage change, that is then fixed for the length of the analysis. The results of using a 2%, 5% and 10% escalator on carbon price and NPV for Project Scenario A are given in Table 7. Notice that increasing the price of a CER by 10% annually, results in the LULUCF credits having no value, due to the associated liabilities. This is because the discount rate is also set at 10% for this analysis and any price escalation would offset the benefits accruing due to the temporary use of LULUCF credits. Only when the discount rate is higher than the price escalation will there still be financial benefits from purchasing credits from LULUCF projects.

3.3. The temporary crediting or T-CER approach

The temporary crediting system has become a popular proposal for addressing the issue of non-permanence of LULUCF projects and it is therefore worth a specific mention. In principle, it has been supported by a number of Parties, in one form or another. The proposal submitted by the European Union has been used as a basis for the temporary crediting system in the EcoSecurities Carbon Accounting Calculator, in particular with the specification of a 5-year credit lifetime. However, three variations in the T-CER approach are used, as described in section 2.1, to reflect some of the other proposals under discussion. It should be noted that some temporary crediting methods, for example the approach proposed by the Colombian delegation (FCCC/SBSTA/2002/MISC.22), do not restrict the credit lifetime to a specified length, but credits are issued with an indefinite expiry date. In the accounting calculator, such approaches are essentially the same as the stock change or average storage methods, depending on which accounting method has been proposed. This is because all liabilities are accounted for by the calculator, as and when they occur, mimicking the expiry of the T-CER.

Table 7: Comparison of credit price and NPV, with price escalator (Project Scenario A, with permanent emission reduction price at 10 U$/tC and discount rate of 10%).

	Price escalator 2%		Price escalator 5%		Price escalator 10%	
Methodology	Credit price (U$/tC)	NPV (U$/ha)	Credit price (U$/tC)	NPV (U$/ha)	Credit price (U$/tC)	NPV (U$/ha)
1a) Stock change – till end of project	4.94	433	3.33	438	-0.01	-3.42
1b) Stock change – till end of crediting period (21 yrs)	5.10	390	3.53	359	-0.01	-1.75
2a) Average storage, fixed denominator	9.98	223	9.88	239	-0.01	-0.27
2b) Average storage, variable denominator	9.68	388	8.80	396	-0.01	-0.55
3a) T-CERs with limited crediting (21 yrs)	3.13	260	2.07	250	-0.01	-2.33
3b) T-CERs till end of project	3.13	326	2.07	365	-0.01	-5.24
3c) T-CERs with limited crediting (21 yrs) and average storage	3.13	271	2.07	261	-0.01	-2.47
4a) Ton-years till end of project	10.00	108	10.00	176	10.00	496
4b) Ton-years with limited crediting (21 yrs).	10.00	90	10.00	126	10.00	231

The choice of a specified lifetime (in this case 5-years) and strict verification timing, as outlined in the EU proposal, are based on decisions unrelated to land use systems (due to commitment periods). As a result, the allocation of credits can vary considerably depending on the combination of rotation length and growth rate, and the choice of initial verification date. It is EcoSecurities understanding that the EU proposal requires 5-yearly verification, in line with the commitment periods. If verification is undertaken in the second year of the first commitment period, then it will take place again in the second year of the second commitment period, the second year of the third commitment period, and so on. The initial verification date fixes the project into a 5-yearly cycle of verification visits. The number of credits that are awarded is equal to the carbon stocks present in the year of verification. Given that the biological cycles of forest systems do not follow a similar 5-yearly cycle, the number of credits awarded is quite arbitrary. This is demonstrated in Table 8, which looks at the impact of selecting the initial verification date. It is assumed that the project developer can choose to be verified in any of the 5 years of the first commitment period, but once this date has been chosen, the project is subsequently locked into a 5-yearly verification cycle.

The Table demonstrates the variability in NPV for the same project activities but with different initial verification date. The difference can be quite substantial. For example, as much as 67 US$/ha separates the highest and lowest NPV for Project Scenario D, method c), which is equivalent to a loss of 52% of the NPV of the credits due to the choice of initial verification date. Similar differences can be observed for the other Project Scenarios and methods, demonstrating the arbitrary allocation of credits to projects and the need for project developers to select their initial verification date with care under such a rigid system.

Note that there is no difference in the NPV for projects of 50-year versus 100-year duration for T-CER approaches a) and c). Only with approach b, which takes into account credits accrued beyond the crediting period, will the effects of changing project duration be seen. However, these impacts are still very small.

Table 8: The impact of year of initial verification on NPV for the different T-CER methods.

		NPV (U$/ha)				
T-CER method	**Year of initial verification**	**E**	**A**	**B**	**C**	**D**
		Project duration: 50 years			*Project duration: 100 years*	
		Rotation: 7 yr	*Rotation: 15 yr*	*Rotation: 40 yr*	*Rotation: 15 yr*	*Rotation: 40 yr*
a) EU proposal (with 21 year crediting period)	*2008*	172	221	111	221	111
	2009	207	224	109	224	109
	2010	135	225	107	225	107
	2011	164	134	105	134	105
	2012	129	116	74	116	74
b) EU proposal (until end of project duration)	*2008*	236	287	184	291	187
	2009	254	291	178	295	181
	2010	187	292	173	296	175
	2011	210	173	157	177	161
	2012	189	180	151	184	155
c) T-CER using average storage (with 21 year crediting period)	*2008*	196	225	130	225	130
	2009	178	204	118	204	118
	2010	162	186	107	186	107
	2011	147	169	98	169	98
	2012	101	137	63	137	63

Based on the outcome of this analysis it does not seem to be appropriate, from the project developers' point of view, to adopt a system with such a rigid verification-timing requirement. A more flexible system could be used that would be appropriate to any project type. Verification is not unique to the T-CER approach, and in fact, a similar impact would be observed for the stock change approach if the project developer undertook verification only periodically. The difference though, is that the developer is not restricted to a 5-year cycle and can choose to be verified annually if they want to and subsequent verification visits are not fixed to the timing of initial verification. The impact of initial verification date is less crucial for the average storage method as a result of the more stable carbon projections over time by averaging dynamic forest systems, and again because timing is the project developer's choice.

3.4. Overview

The calculator proves to be a useful tool in the comparison of different methodologies and the impact of various factors, including forest management and financial factors, on carbon flows and the financial feasibility of projects. Table 9 makes some general observations based on the results of analysis of all the project scenarios. The outputs are graded high (H), medium (M) and low (L) for ease of comparison.

The stock change methods are the most reactive to changes in project scenario, reflecting the variation in project duration and rotation lengths. This method most closely reflects actual carbon flows, rewarding maximum storage, but also accounting for any debits at the time they occur. As a result, the net present value is high when using stock change accounting. Given that the calculator accounts for all planned re-emissions at the time at which they occur, with full liability at the end of the project duration, this method can also be used to simulate the temporary crediting system proposed by the Colombian delegation (FCCC/SBSTA/2002/MISC.22).

Both the ton-year and average storage methods consistently reward the carbon storage with relatively low numbers of credits but high prices. In this case the non-permanence is addressed by the accounting methodology rather than through the price. Full liability is assumed at the end of project duration, therefore the calculator assumes that carbon storage is temporary and this method can be used to simulate proposals for temporary crediting with average storage.

Meanwhile, the actual temporary crediting system used by the calculator is the T-CER approach limited to 5-year credit lifetimes (based on the EU proposal, see attached). The T-CER system has consistently low credit prices to reflect the short-term nature of storage and liabilities associated with credit expiry.

Table 9: Overview comparison of methodologies for project scenario A.
H = High; M = Medium; L = Low

Methodology	Credits accrued					Credit price					Fixed crediting period	Verification timing	Net present values
	A	***B***	***C***	***D***	***E***	***A***	***B***	***C***	***D***	***E***			
1a) Stock change – till end of project	H	M	H	H	H	M	H	M	H	L	Not appropriate for land use systems unless very long term (e.g. 100 years)	Project developer's choice	High
1b) Stock change – till end of crediting period (21 yrs)	M	L	M	L	H	M	H	M	H	L			Medium
2a) Average storage, fixed denominator	L	L	L	L	L	H	H	H	H	H			Medium-low
2b) Average storage, variable denominator	L	L	L	L	L	H	H	H	H	H			Medium
3a) T-CERs with limited crediting (21 yrs)	M	M	M	M	M	L	L	L	L	L		Fixed 5-yearly results in arbitrary allocation of credits	Medium-low
3b) T-CERs till end of project	H	H	H	H	H	L	L	L	L	L			
3c) T-CERs with limited crediting (21 yrs) and average storage	H	M	H	M	H	L	L	L	L	L			
4a) Ton-years till end of project	L	L	M	L	L	H	H	H	H	H		Project developer's choice	Low
4b) Ton-years with limited crediting (21 yrs).	L	L	L	L	L	H	H	H	H	H			

4. Case study projects

The following sections show the results of applying the carbon accounting calculator to the four case study projects: Guaraquecaba, Noel Kempff Climate Action Project, Rio Bravo and the Romania afforestation project. The carbon accounting calculator assumes that data is input on a per hectare basis, in terms of the tool's units and labels. Therefore, the carbon stocks over time have been divided annually by the total number of hectares of each project (Table 10). Data can be input as total carbon stocks on a project wide basis, but this should be born in mind when interpreting the results, for example, labels that say tC/ha will actually be tC. The project wide results for the case studies are also given below (Table 12).

Table 10: Area of the case study projects.

Project	Activity	Area (hectares)
Guaraquecaba	Rehabilitation and conservation	918.40
Noel Kempff Project	Conservation (stop logging and avoided deforestation)	675,444.00
Rio Bravo	Conservation	10,091.00
Romania afforestation	Afforestation	6,728.00

Table 11 summarises the results in terms of net present value for all the projects. The huge differences between the projects, for example the Rio Bravo versus the Noel Kempff project is primarily a function of the area covered by the project. The Noel Kempff project covers a vast area, not all of which contributes to the net carbon benefits being accrued by the project. Therefore, by analysing on a per hectare basis the carbon benefits are diluted considerably compared to the other projects. The Romania project by contrast is an afforestation project and therefore more closely reflects the per hectare activities modelled earlier in the report by the demonstration project, yet no liabilities actually accrue before the end of the fixed 21-year crediting period (because there is no harvesting before this date). The Rio Bravo project has a much higher NPV than the other projects. This is a result of two factors: the intensity of activities per hectare, and the front-loading of credits in the first few years (Figure 8). The results are also presented based on carbon stocks across the whole area of the projects, i.e. not on a per hectare basis (Table 12).

Table 11: Net Present Value for the case study projects, for different accounting methods, per hectare.

	Net Present Value (U$/ha)			
Methodology	Guaraquecaba	Noel Kempff	Rio Bravo	Romania
1a) Stock change – till end of project	34.75	7.45	1004.35	161.02
1b) Stock change – till end of crediting period (21 yrs)	34.72	6.71	995.80	152.39
2a) Average storage, fixed denominator	10.96	3.44	476.30	67.22
2b) Average storage, variable denominator	33.74	6.11	504.95	131.46
3a) T-CERs with limited crediting (21 yrs)	15.10	3.65	657.68	84.61
3b) T-CERs till end of project	17.82	5.82	686.73	128.38
3c) T-CERs with limited crediting (21 yrs) and average storage	14.78	4.47	514.74	106.58
4a) Ton-years till end of project	6.96	1.49	201.08	32.24
4b) Ton-years with limited crediting (21 yrs)	6.39	1.02	167.84	23.01

Table 12: Net Present Value for the case study projects, for different accounting methods, across the whole project.

	Net Present Value (U$)			
Methodology	Guaraquecaba	Noel Kempff	Rio Bravo	Romania
1a) Stock change – till end of project	31,916	5,032,463	10,134,919	1,083,318
1b) Stock change – till end of crediting period (21 yrs)	31,884	4,531,995	10,048,644	1,025,302
2a) Average storage, fixed denominator	10,064	2,320,852	4,806,299	452,240
2b) Average storage, variable denominator	30,988	4,127,126	9,858,968	884,458
3a) T-CERs with limited crediting (21 yrs)	13,864	2,463,167	5,095,405	569,264
3b) T-CERs till end of project	16,364	3,934,279	6,636,633	863,761
3c) T-CERs with limited crediting (21 yrs) and average storage	13,573	3,018,176	5,194,227	717,048
4a) Ton-years till end of project	6,390	1,007,841	2,029,084	216,936
4b) Ton-years with limited crediting (21 yrs)	5,873	691,351	1,693,641	154,785

Both the Guaraquecaba and Rio Bravo projects have carbon stocks that accrue rapidly in the first few years of the project (Figures 4 and 8) and then remain relatively static until the end of the project duration (with the exception of Guaraquecaba, which has some fluxing). As a result, these two projects have consistently higher credit prices across the range of methods when compared to the Noel Kempff and Romania projects that accrue credits more slowly (Figures 6 and 10).

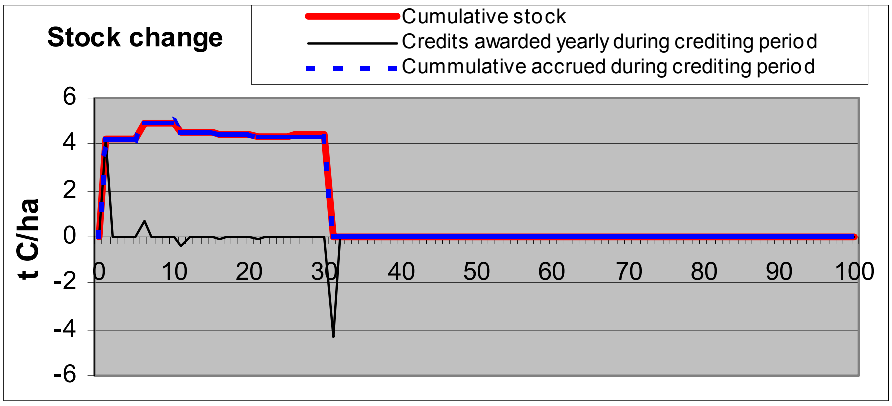
Credit prices for the T-CERs remain low across all projects as a result of the requirement to retire and renew credits on a 5-yearly cycle and therefore account for potential liabilities. It should be remembered though, that this exercise values the credits based on potential liabilities associated with the accounting approach when compared to full emission reductions from non-LULUCF projects. In reality, the price an investor is prepared to pay may be very different.

4.1. The Guaraquecaba project, Brazil

Figure 3: Results for Guaraquecaba project, Brazil.

Results (tC)	**Credits accrued**	**Credits returned**	**NPV**	**Relative prices** (U$/t C)
1) Stock change				
Maximum storage	4.91			
Stock change crediting until end of project	5.03	-5.03	34.75	9.03
Stock change crediting during limited crediting period	4.91	-4.91	34.72	9.05
2) Average storage				
2a) Average storage with fixed denominator	1.33			
Credits awarded during crediting period	1.33	-1.33	10.96	9.99
2b) Average storage with variable denominator	4.47			
Credits awarded during crediting period	4.47	-4.47	33.74	9.35
3) T-CERs - based on the EU proposal				
3a) T-CERs - limited to crediting period	13.83	-13.83	15.10	3.78
3b) T-CERs - not limited to crediting period	22.61	-22.61	17.82	
3c) T-CERs - limited to crediting period, with average storage	13.60	-13.60	14.78	
4) Ton years				
Until end of project	2.44	0.00	6.96	10.00
Until end of limited crediting period	1.72	0.00	6.39	

Figure 4: Graphic presentation of carbon and credit flows for the Guaraquecaba project, Brazil.

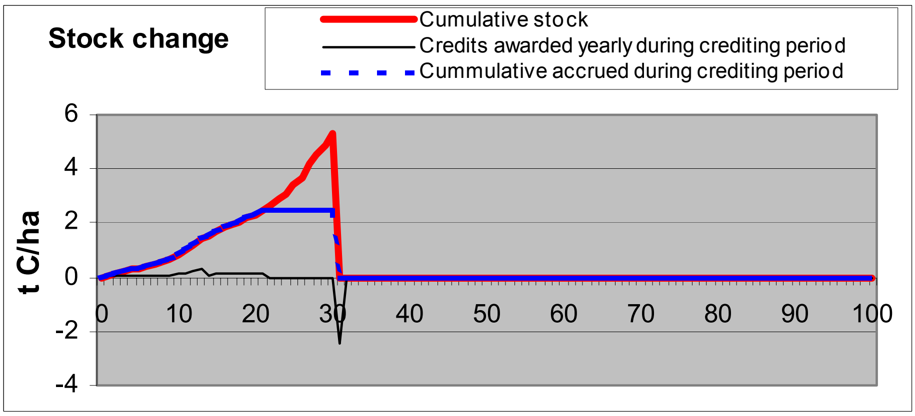


4.2. The Noel Kempff Climate Action Project, Bolivia

Figure 5: Results for the Noel Kempff project, Bolivia.

Results (tC)	**Credits accrued**	**Credits returned**	**NPV**	**Relative prices (U$/t C)**
1) Stock change				
Maximum storage	5.32			
Stock change crediting until end of project	5.32	-5.32	7.45	7.46
Stock change crediting during limited crediting period	2.49	-2.49	6.71	8.50
2) Average storage				
2a) Average storage with fixed denominator	0.58			
Credits awarded during crediting period	0.58	-0.58	3.44	9.99
2b) Average storage with variable denominator	1.94			
Credits awarded during crediting period	1.94	-1.94	6.11	8.57
3) T-CERs - based on the EU proposal				
3a) T-CERs - limited to crediting period	4.10	-4.10	3.65	3.78
3b) T-CERs - not limited to crediting period	11.49	-11.49	5.82	
3c) T-CERs - limited to crediting period, with average storage	4.87	-4.87	4.47	
4) Ton years				
Until end of project	1.06	0.00	1.49	10.00
Until end of limited crediting period	0.43	0.00	1.02	

Figure 6: Graphic presentation of carbon and credit flows for the Noel Kempff project, Bolivia.

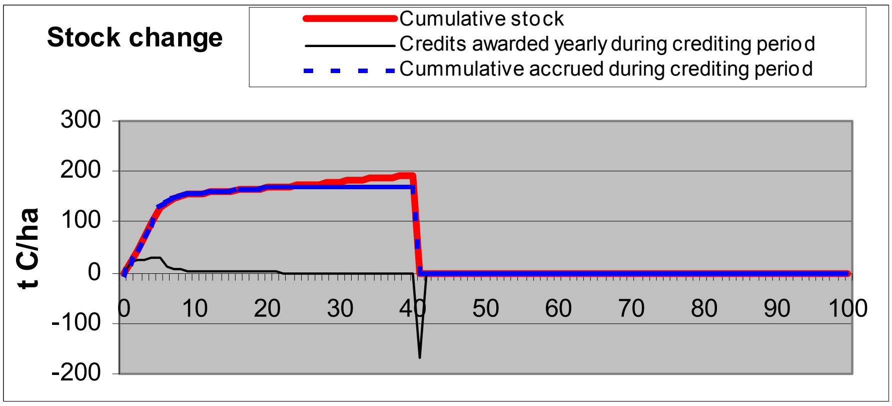


4.3. The Rio Bravo project, Belize

Figure 7: Results for the Rio Bravo project, Belize.

Results (tC)	Credits accrued	Credits returned	NPV	Relative prices (U$/t C)
1) Stock change				
Maximum storage	193.67			
Stock change crediting until end of project	193.67	-193.67	1,004.35	9.65
Stock change crediting during limited crediting period	168.75	-168.75	995.80	9.69
2) Average storage				
2a) Average storage with fixed denominator	62.95			
Credits awarded during crediting period	62.95	-62.95	476.30	9.99
2b) Average storage with variable denominator	158.95			
Credits awarded during crediting period	158.95	-158.95	977.01	9.67
3) T-CERs - based on the EU proposal				
3a) T-CERs - limited to crediting period	476.95	-476.95	504.95	3.78
3b) T-CERs - not limited to crediting period	1,200.25	-1,200.25	657.68	
3c) T-CERs - limited to crediting period, with average storage	485.34	-485.34	514.74	
4) Ton years				
Until end of project	115.60	0.00	201.08	10.00
Until end of limited crediting period	52.91	0.00	167.84	

Figure 8: Graphic presentation of carbon and credit flows for the Rio Bravo project, Belize.

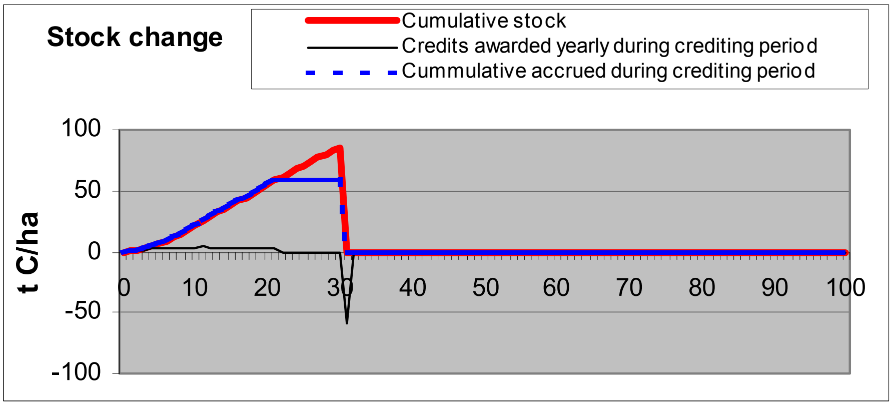


4.4. The Romania Afforestation project

Figure 9: Results for the Romania afforestation project.

Results (tC)	Credits accrued	Credits returned	NPV	Relative prices (U$/t C)
1) Stock change				
Maximum storage	85.63			
Stock change crediting until end of project	85.63	-85.63	161.02	7.98
Stock change crediting during limited crediting period	58.37	-58.37	152.39	8.46
2) Average storage				
2a) Average storage with fixed denominator	11.98			
Credits awarded during crediting period	11.98	-11.98	67.22	9.99
2b) Average storage with variable denominator	40.32			
Credits awarded during crediting period	40.32	-40.32	131.46	8.61
3) T-CERs - based on the EU proposal				
3a) T-CERs - limited to crediting period	94.45	-94.45	84.61	3.78
3b) T-CERs - not limited to crediting period	238.85	-238.85	128.38	
3c) T-CERs - limited to crediting period, with average storage	114.70	-114.70	106.58	
4) Ton years				
Until end of project	21.99	0.00	32.24	10.00
Until end of limited crediting period	9.93	0.00	23.01	

Figure 10: Graphic presentation of carbon and credit flows for the Romania afforestation project.



5. Conclusions

A number of observations can be made based on the analysis undertaken using the EcoSecurities Carbon Accounting Calculator. The stock change approach most closely follows the carbon stocks of a project, both rewarding up to maximum storage and accounting for liabilities as and when they occur, therefore maintaining the environmental credibility of the accounting system. In contrast, the average storage approach does not reward maximum storage and therefore results in consistently lower amounts of credits being given compared to the stock change approach. For some land use systems, it does avoid the issue of needing regular crediting and debiting, which is a feature inherent to the stock change approach. However, if average storage accounting were to be adopted, there would need to be agreement on the means of calculating the average, and in particular, specification of the denominator to be used. Some proposals exist that combine the use of average storage with the T-CER approach (FCCC/SBSTA/2002/MISC.22) that would imply the use of the T-CER lifetime, e.g. 5 or 7 years, as the denominator for calculating average storage.

The temporary crediting system as proposed by the EU proposal has a number of peculiarities, notably the specification of:

a) a 5-year credit lifetime (to fit in with commitment periods);
b) required retirement and re-issuance linked to the 5-year period (and therefore associated liabilities at that time);
c) verification timing once in every commitment period (5-year period);

It has been shown that these combined specifications have led to the arbitrary allocation of credits, unrelated to the activities being undertaken, and consequently may result in over or under crediting. If this system is adopted, project developers will need to analyse in detail the potential impact of verification timing and forest management activities on the number of carbon credits that will be allocated and therefore on potential project income.

However, there are a number of proposals for temporary crediting presently under discussion, and some of these can also be analysed using the EcoSecurities Carbon Accounting Tool. This includes proposals for using stock change or average storage accounting that combine with temporary crediting systems with lifetimes that are unspecified or with indefinite expiry dates (FCCC/SBSTA/2002/MISC.22). The stock change and average storage approaches used in the calculator essentially mimic the credit flows that might occur when using a temporary crediting system with more flexible credit lifetime. As a result, proposals such as that described in the Colombian submission (FCCC/SBSTA/2002/MISC.22), maintain the environmental integrity of the credits through accounting for re-emissions at the time at which they occur, whilst avoiding the problems of imposing specific, and often arbitrary, credit lifetimes.

Limiting the maximum number of years over which a project can claim credits has been shown to have important implications for certain projects, particular given that existing rules for CDM projects limit crediting to a maximum of 21-years. This restriction will favour projects that plant fast growing tree species and will not reward the carbon sequestered by, and stored in, slower growing species. Therefore it is an inappropriate restriction for land use projects and this maximum should be extended.

References

Moura-Costa, P. and C. Wilson, 2000: An equivalence factor between CO_2 avoided emissions and sequestration – description and applications in forestry. *Mitigation and Adaptation Strategies for Global Change* 5: 51-60.

Appendix: Description of the EU proposal for temporary crediting

eu2002.dk

EU paper at COP8 of the UNFCCC
Delhi, 24 October 2002

How to account for temporary CERs

A distinct feature of sink activities is the risk that carbon stocks sequestered will subsequently be released and hence, the greenhouse gas benefits of the CDM A/R project activity will be reversed (issue of *non-permanence*). The EU has therefore further developed the proposal that was tabled in its original form by Colombia, for dealing with non-permanence in a way that avoids penalising projects where reversal does not occur, and guarantees complete replacement (with a delay of at most one commitment period) of the lost carbon if there is reversal. For the proposal see the EU submission in FCCC/SBSTA/2002/MISC.22, page 38ff.).

In developing its proposal the EU was guided by the following principles:

- to provide a transparent and effective system, which ensures that any losses of greenhouse gas benefits can be swiftly and fully compensated for,
- to be integrated with accounting rules for Annex I countries and to be consistent with monitoring, verification and certification rules.

The essence of this proposal is that credits from A/R CDM project activities are valid to meet commitments in the Commitment Period in which they were issued, and expire five years after issuance. Because they expire, the credits have been called Temporary Certified Emissions Reduction Units (TCERs). After the TCERs have expired, a new verification can lead to the re-issuance of TCERs for the same carbon stock. Verification will either show that equal or more carbon stock is in place, in which case correspondingly equal or more TCERs are re-issued, again with a validity period of 5 years. Alternatively, if verification shows that all or part of carbon stocks are no longer in place (i.e. that there has been reversal), correspondingly fewer TCERs will be issued and the reversal will be fully compensated for. In accounting terms “compensation” means that expired TCERs will need to be replaced by other units (see section 5 below).

In accordance with the length of the commitment period, the validity period of TCERs has been set to 5 years after issuance. This was done in order to reflect principle 1 (g) of Draft decision –/CMP.1 (LULUCF), i.e. that reversal of any removal due to LULUCF activities be accounted for at the appropriate point in time. In this context, “appropriate” was interpreted as a delay of at most one commitment period.

The concept of TCERs can easily be integrated in the rules on the accounting of assigned amounts and registries (Decision 19/CP.7). How this can be done is elaborated below. The EU is open to discuss other ways of operationalising the concept that would match the above principles.

1. Issuance

Like CERs, after verification and certification by an Operational Entity TCERs are issued by the executive board into the pending account of the Executive Board in the CDM registry, a share of proceeds is forwarded to the appropriate account of the Executive Board and the remaining units are forwarded to the registry accounts of the Parties and project participants involved. The only difference is that TCERs will have to have the expiry date (month and year) as an additional element in their serial number. The TCER shall be considered as a valid unit until the end of the expiry date.

This validity period of a TCER shall be five years, i.e. a TCER issued in January 2009 shall be valid until the end of January 2014.

2. Holding & Transfer
Like all other units, a TCER can be held in the holding accounts of Parties and transferred between Parties (see also section 7 on the Independent Transaction Log).

3. Carry-over
TCERs can only be used for the purpose of compliance in the commitment period in which they were issued. This implies that TCERs, like RMUs, cannot be carried over from one commitment period to the next. This is proposed because the same principles that have governed the treatment of RMUs within the modalities for accounting of assigned amounts will need to govern credits generated from A/R CDM project activities, reflecting principle 1 (f) of Draft decision –/CMP.1 (LULUCF), i.e. that accounting for LULUCF activities does not imply a transfer of commitments to a future commitment period.

4. Retirement
Like all other units, a TCER can be used by an Annex I Party to demonstrate compliance by being moved to the Retirement Account of the commitment period. Only those TCERs are available for retirement that have been issued in the same commitment period, i.e. that are still valid at the end of that commitment period. For reasons of transparency it might be considered to add to the existing Retirement Account of each Commitment Period a separate Retirement Account for each Commitment Period which contains all retired TCERs in order to be able to identify quickly and in a transparent way all retired units that will expire.

5. Procedure on Expiry Date ("Replacement")
Essentially, this is the new accounting feature of TCERs: Upon expiry, TCERs that have been retired will have to have their function taken over by other units. Due to their lifetime of 5 years, TCERs cannot expire during the commitment period they were issued. They can also not be carried over (see section 3). Therefore, action is only necessary if TCERs in the Retirement Account expire. If a TCER expires in the Retirement Account of a Party, this Party is obliged to move an AAU, CER, ERU or RMU from its current holding account into its current cancellation account[3]. To be able to check that AAUs, CERs, ERUs or RMUs were cancelled for the purpose of "replacing" expired TCERs it will be necessary to add to the existing Cancellation Accounts of each Commitment Period another Cancellation Account for each Commitment Period in which the units which replace TCERs are cancelled.

One variation of this procedure could be to allow "replacement of TCERs" also by TCERs which would require tracking of TCERs in the cancellation account as well.

6. Reporting
In the annual reporting on ERUs, CERs, AAUs and RMUs under Article 7.1 each Party will need to also report on the amount of TCERs that were retired during the previous year, including information on the expiry dates of the TCERs. Furthermore, each Party will have to report on the amount of TCERs that expired during the previous year in the retirement account of the previous commitment period. Each Party will also have to show in the annual reporting that the amount of units that were cancelled during the previous year into the cancellation account for replacing TCERs is equal to the amount of TCERs that have expired during that previous year.

7. Independent Transaction Log
The independent transaction log will perform the same checks for the transfers of TCERs as for RMUs, i.e. that no TCERs are carried over and that no TCER which has been moved to a retirement account is further transferred. Furthermore, the transaction log would need to check that no expired TCER is retired nor transferred between Parties. Note also that the transaction log is already obliged by the Marrakech Accords to check that the amount of acquisitions of units resulting from A/R CDM

[3] Note that the unit expires in the retirement account of the commitment period "t", while the cancellation occurs in the commitment period "t+1" due to the 5-year-validity period of the TCERs. The expiry therefore does not affect the compliance assessment for the commitment period "t" but only that of the commitment period "t+1".

project activities by a Party does not infringe on the limits set in Decision 17/CP.7 (see paras 42 (c) of Decision 19/CP.7).

8. Re-Issuance of TCERs
As the original TCERs have expired and were removed from the system, new TCERs can be issued based on the change in carbon stock since the beginning of the project. These TCERs will again be valid for another 5 years. If more carbon has been stored than 5 years ago, more TCERs are issued than before. If less carbon has been stored, less TCERs are issued. If verification shows that the carbon is still in place, this procedure will generate a string of TCERs until the end of the crediting period of the project. This process must not take place more frequently than at five year intervals, to avoid more than one TCER being in circulation for a given unit of carbon.

9. Prompt Start of CDM A/R project activities
All carbon stored since the start of the project will be eligible for crediting. Therefore projects starting as from 2000 under the prompt start of the CDM are accommodated for under the proposed accounting procedure.

The EU is currently analysing whether the verification and certification of an AR CDM activity prior to 2008 will require special accounting provisions.

10. An example of this accounting procedure
We take an imaginary project that starts in 2003. First verification will occur in 2011 (see Figure 1). The carbon stock over the baseline has increased by 3 tCO_2eq, accordingly 3 TCERs are issued in 2011 valid until 2016. These TCERs are retired in 2012 into the Retirement Account for the first commitment period and are used to fulfil the commitments in that period (Figure 2 a).

In 2016, the first set of TCERs expires. The expiry of the TCERs in 2016 does not affect the compliance with the first commitment period, since they were valid units within the first commitment period and when compliance is assessed, they can be found in the retirement account of the first commitment period. The fact that the 3 TCERs expire is compensated by cancelling three AAUs (Figure 2b) into the Cancellation Account of the second commitment period for units replacing TCERs. These cancelled AAUs can now no longer be used to fulfil the commitments in the second commitment period. Also in 2016, the project is again verified. Now the stock over the baseline is 8 tCO_2eq (Figure 1), accordingly 8 TCERs are issued, 5 more than in 2011 (Figure 2 b). These TCERs are retired in 2017 into the Retirement Account of the second commitment period and used to fulfil the commitments in that period.

In 2021, the second set of TCERs expires. The fact that the TCERs expire is compensated by cancelling 8 AAUs (Figure 2c). Also in 2021, the project is again verified. Now the stock over the base line is only 6 tCO_2eq (e.g. due to a fire), accordingly 6 TCERs are issued, 2 less than in 2008 (Figure 2 c). These TCERs are retired in 2022 into the Retirement Account of the third commitment period and used to fulfil the commitments in that period.

This process then continues until the end of the crediting period of the A/R CDM project activity.

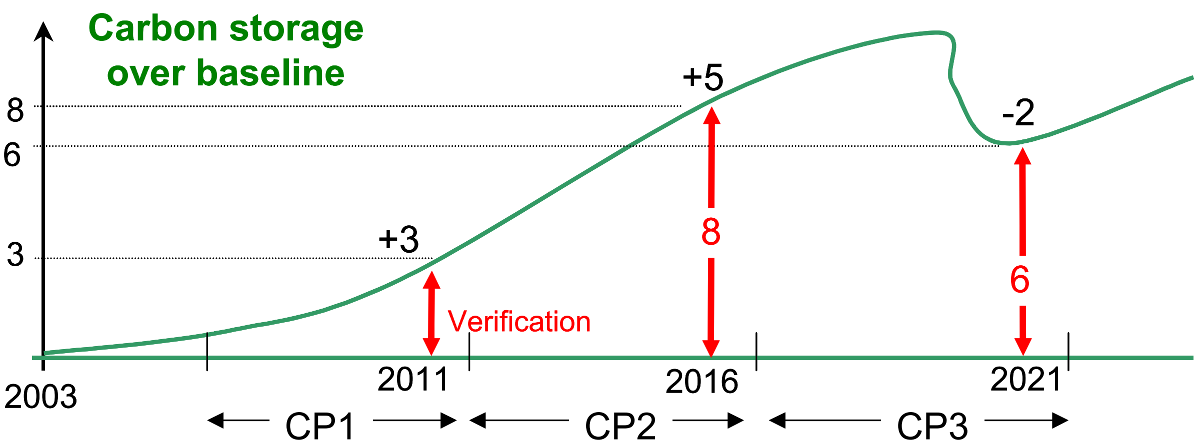


Figure 1. Storage of carbon of an example project

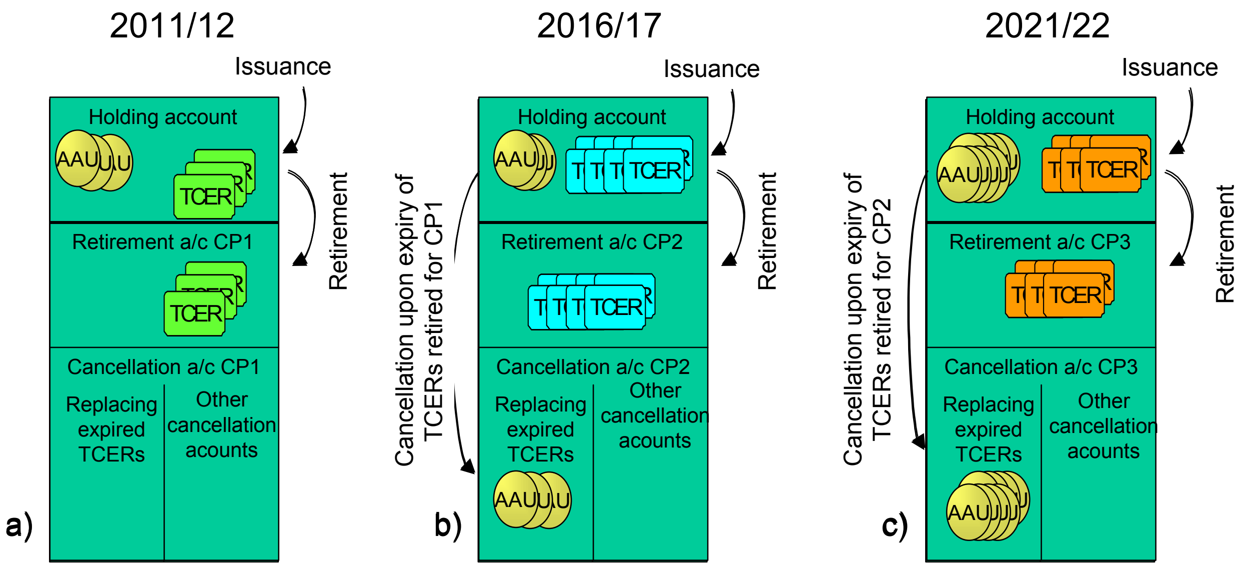


Figure 2. Transactions in the registry for the example project.