



LEONARDO ACADEMY
THE SUSTAINABILITY EXPERTS®

**Defining Forest Sequestration Impacts:
Tonne to Tonne-Year Correlations
Implicit in Existing Forestry Offset Standards**

A White Paper

By Leonardo Academy Inc.

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White Paper

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PREFACE

This is the December 8, 2009, Leonardo Academy white paper analyzing the carbon sequestration impacts implied in standards that address existing forests.

OBJECTIVES

This white paper is being prepared and issued with several goals in mind:

- To bring to light the assumptions about tonnes of carbon sequestered in forests over time that is implied in emissions protocols.
- To discuss the use of tonne-years as a metric for measuring the true effect of carbon sequestered in forests.
- To analyze several carbon offset standards to determine the length of time a tonne of carbon is required to be sequestered in order to earn offset credit.
- To ascertain the value of tonne-years in the current carbon offset market.

Please contact Leonardo Academy if you have any questions, comments, or suggestions for this white paper.

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SECTION 1: INTRODUCTION

Forestry offset programs seek to reward forestry activities that hold carbon in forests. The question of *how long* the carbon is held in a forest is an issue that is inherently dealt with in all forest carbon sequestration protocols. By addressing this matter directly, we can bring to light how this time factor is currently dealt with in offset protocols and gain insight into how it can be addressed more effectively to provide a better incentive for the long-term maintenance of carbon sequestration in forests.

Put simply, of all forestry activities, it is the holding of the carbon in forests that helps prevent climate change. Planting new forests is beneficial because it increases the carbon held as the forest grows, therefore removing carbon from the atmosphere. Maintaining existing forests is beneficial because it prevents the release of the carbon held by the forest. The importance of this latter effort is bolstered by scientific research which has shown that between 12¹ and 20² percent of the annual global atmospheric carbon dioxide increase results from forest destruction.

Notably, while current offset protocols are beginning to recognize and grant offset credits to existing forest maintenance activities in limited ways, they do not require participants to maintain credited carbon stocks for an infinite length of time. Consequently, implicit in each offset program is a minimum number of years that a tonne of credited carbon must remain sequestered. Rather than concealing the important time aspect embedded in these forest sequestration offsets, we argue that the key metric for measuring the impact of carbon sequestration in forests must capture both the quantity of carbon that is held in the forest and the length of time that the carbon is held. This metric is expressed as tonne-years.

DEFINITION OF TERMS

The terms defined here are important for understanding the following discussion.

- *Tonne-year of forest carbon sequestration:*
One tonne of carbon held in a forest for one year. Tonne-years are what measure the impact of forests on preventing climate change, because in addition to measuring the amount of carbon held (tonnes), they take into account the duration that carbon is held in the forest in lieu of being released into the atmosphere (years).
- *Tonne of forest carbon sequestration:*
The number of tonne-years an emissions offset protocol defines as being able to offset a tonne of carbon emissions. While it is often not explicitly expressed in these offset standards, there is always an implicit ratio or range of ratios between tonnes and tonne-years of carbon sequestration. For instance, if a carbon offset standard requires credited stands to exist for a minimum of four years, the ratio of tonnes to tonne-years would be 1 to 4. This ratio ultimately defines the level of incentive provided by the emissions protocol to forest owners for each tonne-year of carbon held in their forests, with higher ratios equating to higher incentives.

¹ G.R. Van der Werf et al, Nature Geoscience 2m 737-738 (November 2009) doi:10.1038/ngeo671

Summary online at: <http://www.falw.vu/~gwerf/>

² IPCC Fourth Assessment Report, 2007, Working Group III Report, "Mitigation of Climate Change." <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>

THE KEY FOREST CARBON SEQUESTRATION ISSUES THAT OFFSET PROTOCOLS MUST ADDRESS

There are two key issues that must be addressed by emissions offset protocols that recognize the climate change mitigation impacts of forests.

- Providing effective and verifiable metrics to measure the impacts of forests on atmospheric CO₂ over time (tonne-years)
- Choosing the appropriate tonne to tonne-year ratio to provide an adequate incentive to forest owners to maintain and increase the amount of carbon held in their forests each year

WHAT IS THE APPROPRIATE TONNE TO TONNE-YEAR RATIO?

The appropriate ratio of tonnes to tonne-years is one that provides an adequate incentive to forest owners to maintain their forests as forests, either maintaining or increasing the amount of carbon held in the forests each year. Research shows that forest destruction causes 12³ to 20⁴ percent of the carbon dioxide emitted each year worldwide. While there are many political, social, and economic factors that determine the fate of world forests, the current rate of forest destruction makes it clear that, among other issues, the current tonne to tonne-year ratio is too low.

³G.R. Van der Werf et al, Nature Geoscience 2m 737-738 (November 2009) doi:10.1038/ngeo671
Summary online at: <http://www.falw.vu/~gwerf/>

⁴ IPCC Fourth Assessment Report, 2007, Working Group III Report, "Mitigation of Climate Change." <http://www.ipcc.ch/ipccreports/ar4-wg3.htm>

SECTION 2: DISCUSSION OF THE APPROACHES OF CURRENT EMISSIONS PROTOCOLS TO THE DURATION OF FOREST CARBON SEQUESTRATION

Because carbon held in forests and forest products is at risk of subsequent re-release into the atmosphere, existing emissions protocols seek to mitigate these risks by establishing requirements and crediting policies such as binding forest maintenance contracts, minimum participation periods, buffer/reserve pools (to insure against carbon stocks lost due to natural causes), and offset retirement penalties (for intentional losses of carbon stocks). However, emissions protocols do not require participants to maintain credited carbon stocks for an infinite length of time. Consequently, implicit in each offset program is a minimum number of years that credited carbon must remain sequestered.

To determine the quantity of tonne-years contained within each “permanent” offset tonne awarded, Leonardo Academy researched three prominent US forest carbon offset standards: the Chicago Climate Exchange (CCX), the Voluntary Carbon Standard (VCS), and the Climate Action Reserve (CAR).

TONNE TO TONNE-YEAR RATIOS

In determining the ratio of tonnes to tonne-years under each of the three standards, it was assumed that after a forest project owner is no longer subject to any contractual agreements or other penalties under the offset program, the future existence of that forest is no longer assured. Therefore, any ongoing maintenance of the previously credited sequestered carbon is not assumed due to a lack of continued incentive.

Potential forest project crediting scenarios were then modeled to represent “extremes” of various intersecting offset crediting features under each standard. These standard-specific requirements are designed to assign greater reward to greater forest longevity or that otherwise impact the tonne to tonne-year ratio (e.g. shortest and longest possible crediting period, zero increase to substantial increase in carbon sequestration over the crediting period, highest and lowest project risk ratings, etc.) to determine the widest span of potential ratio values for projects that abide by all protocol rules.

The results of the analysis showed that the tonne to tonne-year ratio varied significantly among the standards. Furthermore, the tonne to tonne-year ratio spans a wide range within each standard, and is impacted by such characteristics as duration of the crediting period, net change in carbon sequestration over time, and project risk ratings. Table 1 below describes the number of tonne-years associated with each one tonne offset awarded under each standard.

Table 1: Tonne to Tonne Year Correlations in US Forestry Standards

| Offset Program | Offset Type | Highest Possible Ratio | Highest Likely Ratio | Lowest Likely Ratio | Lowest Possible Ratio |
|----------------|-------------|------------------------|----------------------|---------------------|-----------------------|
| CCX | CFI | 1:1 | 1: 8 | 1:15 | 1:18 |
| VCS | VCU | 1:19 | 1:25 | 1:100 | 1:102 |
| CAR | CRT | 1: 112 | 1: 126 | 1:222 | 1:250 |

Clearly, the Chicago Climate Exchange protocol ensures the maintenance of sequestered credited carbon for the least amount of time (about 8 – 15 years), the Climate Action Reserve for a significantly longer time (about 126 – 222 years), and the Voluntary Carbon Standard for a span of time in the middle (25 – 100 years).

COST COMPARISON OF OFFSETS BY TONNE-YEAR

Interestingly, Carbon Financial Instruments (CFIs), Voluntary Carbon Units (VCUs), and Climate Reserve Tonnes (CRTs) generated by forestry projects trade at monetary values that roughly inversely correlate to the tonne: tonne-year ratios described above, as depicted in the graphs below.

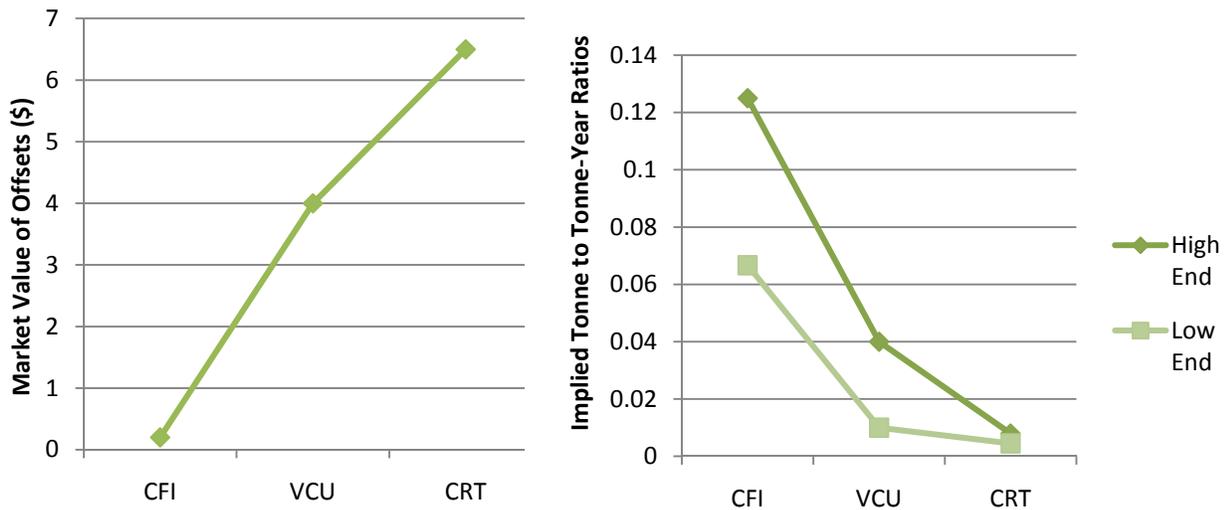


Table 2 below compares these two data sets to determine the current market pricing of a tonne-year of sequestered carbon.

| Table 2: Offset Cost to Tonne-Year Comparison | | | | | |
|---|-----------------------------|--------------------------------|---------------|---------------------------------|---------------|
| Offset Type | Current Market (Bid) Price* | Tonnes per Tonne-Year, Low End | \$/Tonne-Year | Tonnes per Tonne-Year, High End | \$/Tonne-Year |
| CFI | \$0.20 | 1:15 | \$0.01 | 1:8 | \$0.03 |
| VCU | \$4.00 | 1:100 | \$0.04 | 1:25 | \$0.16 |
| CRT | \$6.50 | 1:222 | \$0.03 | 1:126 | \$0.05 |

*Based on 9/7/09 - 9/13/09 prices (www.carbonoffsetsdaily.com)

If one sets aside the high-end VCU value as an outlier, there is currently a one to five cent range of values for a tonne-year of carbon sequestered. It cannot be assumed that the quantity of tonne-years implicit in each one tonne offset awarded under the individual standards is the only reason for the variation in price among CFIs, VCUs, and CRTs. However, it does appear that the stringency of these standards – including the length of time for which the carbon must be held in the forest – does have a significant impact on the value the market places on these offsets.

Because the carbon offset market is already valuing forest sequestration offsets in a way that rewards a greater number of tonne-years per tonne, introducing disclosures about the relationship between these two metrics in the offset market is a logical next step toward greater market transparency and helping consumers make informed choices among offset commodities.

SECTION 3: CONCLUSION

While there is currently no universal term used to account for the length of time that forestry carbon offsets must be maintained, it is evident that it is implied in emissions standards and offset market values and should be made explicit to both offset providers and purchasers. The implementation of tonne-years as a metric, as defined in this paper, would not only clarify the true impact that a tonne of carbon offsets has on climate change, but would also provide a common language for the comparison of existing forest carbon offsets.

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