

***DRAFT***  
**Urban Forest Project  
Reporting Protocol**

Version 1.0  
July 7, 2008



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## 1 Introduction

The California Climate Action Registry's (California Registry) Urban Forest Project Reporting Protocol provides guidance to account for and report greenhouse gas (GHG) emission reductions associated with a planned set of tree planting and maintenance activities to permanently increase carbon storage in trees.

The California Registry is a leading source of accurate, transparent, and credible GHG accounting standards for reporting entity-wide GHG emission inventories. The California Registry also applies its knowledge and expertise in GHG accounting to the quantification of GHG emission reductions associated with specific project activities, to ensure the environmental integrity of programs based on these data and to support international efforts to combat climate change. Through its Climate Action Reserve program (the Reserve), the California Registry supplies protocols such as this one for quantifying GHG emission reductions (or offsets). In addition, it oversees and accredits independent third-party verifiers, and provides a web-based publicly accessible offset registration, serialization, and tracking service.

Project developers that implement tree-planting programs use this document to register GHG reductions with the Reserve. It provides eligibility rules, methods to calculate reductions, performance monitoring instructions, and procedures for reporting project information to the Reserve. Additionally, all project reports receive annual, independent verification by California Registry-approved verifiers. Guidance for verifiers to certify reductions is provided in the corresponding Urban Forest Project Verification Protocol.

### Document Organization

California Registry's Urban Forest project protocol has the following sections:

- The GHG Reduction Project
- Project Eligibility
- The Project Boundary
- GHG Reduction Calculation Methods
- Permanence
- Co-benefits and Negative Impacts
- Project Monitoring
- Reporting Parameters
- Glossary of Terms

Project developers that follow the guidance in this protocol and register GHG reductions with the Reserve must comply with all local, state, and federal tree planting, air and water quality regulations.

To register GHG reductions with the Reserve, project developers are not required to prepare and submit an annual entity-level GHG inventory.

## 2 The GHG Reduction Project

Increasing levels of carbon dioxide and other greenhouse gases (GHG) in the atmosphere are of growing concern globally and locally, and urban forests have a role to play in the fight against climate change. Urban forests can reduce atmospheric carbon dioxide (CO<sub>2</sub>) directly and indirectly. As long as trees are growing, they remove CO<sub>2</sub>

from the air in a process called carbon sequestration, transforming CO<sub>2</sub> into carbon and making use of it to build living matter—leaves, stems, trunk, roots. GHG tree projects that account for the net storage of CO<sub>2</sub> through tree plantings can be reported and registered with the California Climate Action Registry (California Registry) using this Protocol.

Urban forests have two additional, indirect effects on atmospheric CO<sub>2</sub> and other greenhouse gases (e.g. methane, nitrous oxide). First, trees around buildings can reduce heating and air conditioning use (Abdollahi et al. 2000), thereby reducing emissions of GHGs associated with the consumption of electricity, natural gas, and fuel oil. Second, normally when trees die, the stored carbon is released into the atmosphere through decomposition. However, if the biomass from removed trees is used as feedstock for power plants, GHG emissions that would have occurred with other fuel sources are displaced. These indirect benefits may be quantified and reported as co-benefits to the GHG tree project. However, California Registry does not issue Carbon Reduction Tons (CRTs) for indirect GHG emission reductions.

For a more detailed explanation of the role trees play in climate change and how to select and strategically locate trees to maximize GHG benefits, see Annex A.

## 2.1 Project Definition

For the purposes of this protocol, an urban forest GHG project is a planned set of tree planting and maintenance activities to permanently increase carbon storage, taking into account GHG emissions associated with planting and maintenance of project trees.

While project trees are planted for the purposes of the GHG project, tree sites are the primary unit of analysis in urban forest projects. This is because project trees themselves are subject to mortality and other types of losses and therefore may need to be replaced and/or relocated during the project lifetime; tree sites may also need to be relocated during the lifetime of the project (see Section 6 Permanence for details).

Tree plantings should have an average spacing of no less than 5 meters (biomass equations for estimating carbon stock changes are for open-growing urban trees and assume relatively intensive management). Global Positioning System (GPS) coordinates must be taken on all project tree sites. For forest management and conservation activities that occur on large forested tracts within cities ( $\geq 100$  acres contiguously forested), the Forest GHG Protocols should be used.

An entity can assemble several smaller projects into a single project for the purposes of achieving economies of scale and more efficient reporting. (Experts estimate that a project with at least 1,000 project tree sites will benefit from economies of scale). However, reporting, monitoring, and verification practices must follow California Registry's guidance.

In addition to GHG benefits related to carbon storage, project developers may choose to report a project's emission reductions related to energy conservation and use of tree residue as a bioenergy feedstock as co-benefits (see Section 7 Co-benefits). However, such benefits will not be included in the quantification for the issuance of Carbon Reduction Tons (CRTs) for the project.

This protocol is applicable to three specific project types: Urban Forest GHG Projects undertaken (1) in Municipalities, (2) on Educational Campuses<sup>1</sup>, and (3) by Utilities. A project is defined by a specific number of project tree sites, determined a priori, that will be planted and maintained within one of the above types of entities over the project lifetime. If, in the future, the entity wishes to plant more project tree sites than the amount defined under the original project, this constitutes a second, distinct urban tree project. Entities can undertake as many urban tree projects as desired in the future as long as they each, separately, meet the eligibility criteria and reporting requirements in this protocol.

## 2.2 The Project Developer

The project developer can be a municipality, educational institution, utility, and/or a person or organization partnering with any of these entities. As specified above, an urban forest project must take place within one of the three designated types of entities. However, responsibility for tree planting, care, and maintenance activities may reside with the entity or a partner organization/individual, or it may be shared between both. In any case, the roles and responsibilities of the entity and the partner must be specified. In addition, ownership of the GHG reductions must be specified and documented a priori.

## 3 Eligibility

Project developers using this protocol must satisfy the following eligibility rules to register reductions with California Registry. These criteria only apply to projects that meet the definition of a GHG reduction project as defined in this protocol.

### 3.1 Additionality

California Registry strives to support only projects that yield surplus GHG reductions, which are additional to what might otherwise have occurred. That is, the reductions are above and beyond business as usual – the baseline case. Project developers satisfy the “additionality” eligibility rule by passing two tests:

1. The Performance Standard Test; and
2. The Regulatory Test.

#### The Performance Standard Test

Project developers pass the Performance Standard Test by meeting a program-wide performance threshold – i.e. a standard of performance applicable to all urban forest projects. The performance threshold represents “better than business as usual.” If the project meets the threshold then it exceeds what would happen under the business as usual scenario and generates surplus/additional GHG reductions. Past performance of individual urban forest projects is not used to determine business as usual; rather, business as usual is established from an assessment of urban forestry programs as a class.<sup>2</sup>

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<sup>1</sup> As noted in Section 4.1, the physical area owned and/or controlled by the entity determines entity boundaries. In the case of educational campuses, the project developer may define the entity as a single campus or a system of campuses, as long as the definition is clearly stated and the entity can demonstrate that it has ownership and/or control over the physical area.

<sup>2</sup> The California Registry will not be evaluating past performance of any individual project to determine business as usual. However, information on individual urban forest programs is used to compare project performance to the performance threshold. By using this approach, the California Registry invests in

For this protocol, California Registry uses a practice-based threshold, where it serves as “best practice standard” for urban forest tree planting programs. The project must demonstrate that it will meet or exceed the performance threshold and information confirming this, in accordance with the guidance below, must be provided in the project submittal form. Once a project passes the test, it is considered eligible and the test does not need to be repeated in the future.

California Registry developed three separate Performance Standards, one for each type of entity in which a project can be implemented, based upon an evaluation of data on municipalities, educational campuses, and utilities with tree planting programs in the United States. Three datasets were compiled from information on entities with tree planting programs and performance is based either on the rate of increase in urban trees (municipalities and educational campuses) or the number of trees planted per household<sup>3</sup> (utilities). A summary of the performance standard analysis is provided in Annex E.

The performance standard test is based on information for the entity only, even if a partner organization/individual is responsible for tree planting, care, and maintenance.

### ***Municipalities and Educational Campuses***

The performance standards for municipalities and educational campuses are measured in terms of net tree gain (NTG), the annual number of trees planted by an entity minus the annual number of trees removed by an entity, normalized by the average total number of trees in the entity. The performance standard describes the average annual growth rate of the urban tree population—the net annual change in a tree population relative to size of the tree population—and is expressed as a percentage. An entity that implements a GHG project must exceed a predetermined threshold of performance when taking into account the planned project activities.

The performance thresholds for municipalities and educational campuses are set at the median tree population growth rates in the two datasets described in more detail in Annex E. Specifically, the performance standard thresholds are:

- 0.72% for Municipalities, and
- 0.58% for Educational Campuses.

To determine if a project meets or exceeds the performance threshold, a municipality or educational campus must have the following information.

Data describing the entity before the project is implemented:<sup>4</sup>

- Number of trees in the entity where the project will be implemented (A),
- Number of trees planted each year in the entity (B), and
- Number of trees removed each year in the entity (C).

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developing standardized criteria upfront that is used consistently by all project developers. This reduces initial transaction costs to project developers and provides for efficient and consistent project evaluation.

<sup>3</sup> A household is sometimes referred to as a “residential customer.”

<sup>4</sup> Where GHG projects have been implemented within the entity in the past, the entity data for variables A, B, and C include all previous GHG project activities.

Data describing the project activity:

- Average number of GHG project tree sites planted and maintained each year during the project lifetime (D).

Variables A, B, and C above must reflect the most recent trends within the entity that can be attributed to the entity itself. Therefore, data are based on trees that are under the entity's ownership or control only. In addition, variables A, B, and C must be estimated using an annual average over no more than the most recent five year period proceeding the project start date, or using data from a single year occurring at some point during the past most recent five year period.

Variable D reflects the intended total number of GHG project tree sites to be planted, calculated as an average over a period of 100 years because this is the required minimum project lifetime. For example, if a project goal is to plant and maintain a total of 10,000 tree sites, then D is 100 (10,000/100). Note that under Section 6 Permanence, projects must continuously replace dead trees at all tree sites during the project lifetime. This requirement means that a project may, in reality, plant more trees than the planned number of project tree sites (variable D) to comply with the replacement requirement. However, estimates of the number of lost and replaced trees are not needed to estimate project performance.

Calculate the expected entity-level tree population growth rate, including the tree planting levels planned by the project developer, where the rate is relative to the recent historical entity level tree population, using the following formula:

$$[(B-C)+(D)] / A$$

If the expected entity-level tree population growth rate, including the project, exceeds the performance threshold, then the municipality or educational campus will be accumulating urban trees at rate consistent with best practice.

To ensure that GHG reductions are additional, only the carbon sequestration and GHG emissions associated with project tree planting and care that exceed the performance threshold are included in the calculation of GHG reductions. Trees planted in these project tree sites are referred to as "eligible project trees." Follow the steps below to determine the number of eligible project trees.

If the entity performance meets or exceeds the performance threshold without taking into account the project activities [i.e.  $(B-C)/A \geq 0.0072$  or  $0.0058$ ], then all of the planned project trees can be considered in the GHG reduction calculation (i.e. Total Number of Eligible Project Trees Over the Project Lifetime =  $D*100$ ).

Otherwise, (1) calculate the average number of GHG project sites that need to be planted to bring the entity up to the performance threshold (variable X below), (2) subtract this value from D and multiply the result by 100 to get the total number of eligible project trees for the project lifetime (which is 100 years).

1.  $[(B-C)+(X)]/A = 0.0072$  or  $0.0058$
2. Total Number of Eligible Project Trees Over the Project lifetime =  $(D-X)*100$

A GHG project may need to plant more trees than the predetermined number of eligible project trees to meet all criteria in this protocol (i.e. to replace tree losses during the project lifetime).

### **Utilities**

The Performance Standard for utilities is based on the number of trees planted per household. Most utilities do not have tree planting programs that go beyond replacing trees removed during line clearance operations. Some, however, do have programs specifically aimed at storing carbon and conserving energy in residential households. On average, utilities are planting fewer than 400 trees annually in these types of programs.

The performance standard for utilities is 0.004 trees/household. Excluding two outliers, this is the average performance of the utilities surveyed that have residential tree planting programs. See Annex E for details.

To determine if a project meets or exceeds the performance threshold, a utility must have information on:

- Average number of project trees planted and maintained each year during the project lifetime (D), and
- Number of households<sup>5</sup> in the utility service area (E).

As with municipalities and educational campuses, D is an average calculated over 100 years. E is based on data collected in the most recent past five year period (either an annual average or data from a single year), preceding the project start date.

Calculate the number of trees planted annually per household (D/E) according to the planned activities of the project. If it exceeds 0.004, then the project passes the performance standard test.

To determine the number of eligible project trees for the GHG reduction calculation, (1) determine the average number of trees that need to be planted annually to meet the threshold, and (2) subtract this from D.

1.  $X = 0.004 * E$
2. Eligible Project Trees =  $(D - X) * 100$

Average annual tree planting rates over a 100 year period are used to estimate project performance in this step of the protocol. However, these values do not prescribe actual project implementation rates. For example, if the project goal is to plant and maintain 10,000 project trees over the project lifetime, all trees could be planted in the first 5 years after the project start date.

### **The Regulatory Test**

California Registry subjects all greenhouse gas reduction projects to a regulatory test to ensure that the emission reductions achieved would not have occurred in the absence of the project due to federal, state or local regulations. Urban Forest GHG Projects must also exceed any applicable regulations or statutes. Examples include municipal ordinances that require street, park, and parking lot tree planting or local mitigation

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<sup>5</sup> i.e. One residential meter per household.

requirements imposed on a project. Local codes, covenants, and restrictions may require tree planting to buffer adjacent land uses or for other purposes. State laws may prescribe minimum levels of tree planting for energy conservation and other reasons. Trees that are planted to comply with regulatory requirements may not be considered project trees.

## 3.2 Location

Project developers may report projects within California or any other part of the nation. Project tree sites must be located according to guidance in Section 2.1 Project Definition (average spacing of no less than 5 meters) and Section 4.1 Physical Boundary (e.g. along streets, in parks and parking lots, etc.). Thus, Urban Forest Projects are likely to take place in urban or other types of developed areas.

## 3.3 Project start date

California Senate Bill 1771 (Sher) created California Registry in September of 2000 to serve as a platform to record and register GHG reduction activities, among other things. This sent a signal to GHG-emitting entities that project activities could receive recognition for their carbon value. The establishment of California Registry to support GHG reduction activities is the basis for the project start date criterion. All GHG reduction projects implement a planned set of tree planting activities are eligible to register reductions with California Registry if the system started operating on or after January 1, 2001 (and the project meets all other eligibility requirements). Projects that began operating before January 1, 2001, are not eligible to register reductions according to this protocol. For California Registry's purpose, the commencement of operation means when trees are planted and regular maintenance begins.

# 4 The Project Boundary

The project boundary delineates the GHG sources/sinks and gases assessed by project developers to determine the net change in emissions associated with tree planting projects. It is defined both in terms of physical and GHG assessment boundaries.

## 4.1 Physical Boundary

In general, the physical boundary of a GHG project outlines the components of the project operations that are impacted by the project activity, including the physical area covered by the project as well as the specific equipment used by the project. In this protocol, the physical boundary for the project includes:

- The number of eligible project tree sites (determined in Section 3.1),
- Equipment used to plant and maintain the trees, and
- Transportation routes to and from the tree sites from the location where equipment is stored.<sup>6</sup>

Tree sites must be located within the boundary of an entity (i.e. a municipality, educational institution, or utility). Entity boundaries are determined by the physical area

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<sup>6</sup> Transportation routes are included in the project boundary for completeness, because fuel used by tree care and maintenance equipment is considered in the GHG reduction calculation. The literal transportation routes do not need to be specified, as long as the project collects information on annual fuel consumption attributable to the care and maintenance of eligible project trees.

owned and/or controlled by a municipality or educational campus; or the service area covered by a utility.

For each project type, eligible project trees must be planted:

- Along streets, in parks, city golf courses, cemeteries, near city buildings, greenbelts, city parking lots, and other public open space, or on private property in Municipalities;
- Along streets, near classrooms, dorms, office buildings, near recreational fields and other facilities, in parking lots, arboretums, and other open space on Educational Campuses; and
- In parks, streets, parking lots, private property, and open spaces by Utilities.

## 4.2 GHG Assessment Boundary

The GHG Assessment Boundary delineates all relevant GHG sources, sinks and reservoirs that are considered significantly affected by the project activity and must be included in the calculation of GHG reductions.

In this protocol, the GHG Assessment Boundary is defined as the carbon stored in standing trees and GHG emissions from motor vehicles and equipment used in tree care activities.

Other carbon pools, such as shrubs, woody debris, and soil are not reported at this time. Although there is some research quantifying the movement of carbon through these pools, it is difficult to model, measure, and verify how tree planting projects change these carbon pools (Groffman et al. 2006, Kaye et al. 2005; Pouyat et al. 2002). Carbon stored in harvested wood products (HWP) from urban trees is not reported at this time because the quantification methods are complex and only relatively small increases in HWP carbon are anticipated from urban tree projects.

While the GHG Assessment Boundary delineates the GHG sources and sinks that must be reported, optional GHG sources and sinks are also noted below and can be reported as co-benefits.

Required and optional GHG source and sink categories for reporting are as follows:

- Carbon storage in standing trees – mandatory.
- GHG emissions from motor vehicles related to tree planting and care – mandatory.
- GHG emissions from equipment related to tree planting and care – mandatory.
- Reduced GHG emissions from energy conservation – optional.
- Displaced GHG emissions from bioenergy – optional.

Carbon dioxide (CO<sub>2</sub>) is the primary GHG to report for urban forestry projects. CH<sub>4</sub> and N<sub>2</sub>O emissions from tree planting and care do not need to be reported at this time because these emissions are considered to be de minimis.

## 4.3 Leakage

Leakage is an increase in greenhouse gas emissions or decrease in sequestration caused by the project but not accounted for within the project boundary. In the case of urban forest projects, the most likely form of leakage is the shifting of funds and maintenance from non-project tree resources (i.e. trees within the entity that are not part

of the project) to project trees within an entity. For example, if funding is reduced for pruning existing trees to fund a GHG tree planting project, there may be an overall decline in the health of the urban forest within an entity and a long-term increase in mortality. A tree maintenance plan (TMP) is used to assess whether this type of activity-shifting leakage is occurring. Details on the TMP requirements are provided in Section 8 Project Monitoring. If annual expenditures of the entity in one or more program areas decrease by more than 10% from amounts in the initial TMP or from amounts in the previous year TMP without supporting explanations, leakage will be assumed and if confirmed, no carbon reduction can be registered in that year.

Market leakage is less likely in urban forestry. Market leakage involves the modification of the overall timber market as a result of the implementation of a project. Because there is little market for urban forest products and because the investment that entities have made in urban trees is generally greater than any market value, this type of leakage is considered unlikely and therefore negligible in this protocol.

## 5 GHG Reduction Calculation Methods

This section provides the detailed methods for calculating emissions and removals from the mandatory GHG sources and sinks reported annually to California Registry:

- Carbon storage in standing trees: *Annual Project CO<sub>2</sub> Sequestration*
- GHG emissions from motor vehicles related to tree planting and care: *Annual Vehicle CO<sub>2</sub> Emissions*
- GHG emissions from equipment related to tree planting and care: *Annual Equipment CO<sub>2</sub> Emissions*

Project GHG reductions are based on the amount of carbon sequestered in eligible project trees annually minus GHG emissions from the annual planting, care and maintenance of those trees. Below is the general formula for determining annual project GHG reductions.

*Annual Project GHG Reductions =*

*Annual Project CO<sub>2</sub> Sequestration – Annual Vehicle CO<sub>2</sub> Emissions – Annual Equipment CO<sub>2</sub> Emissions*

### 5.1 Quantifying Project CO<sub>2</sub> Sequestration

Each year, the project developer estimates the amount of carbon stored in eligible project trees (carbon stocks) and then uses these data to calculate an annual incremental carbon stock change (carbon sequestration). Carbon stocks are reported in units of carbon dioxide equivalent. The annual change in carbon stocks is the basis for estimating project carbon sequestration.

*Annual Project CO<sub>2</sub> Sequestration = CO<sub>2</sub> stock year<sub>x</sub> – CO<sub>2</sub> stock year<sub>x-1</sub>*

### Quantifying Tree Carbon Stocks

There are three approved approaches to quantifying the annual carbon stocks in eligible project trees, each of which is based on direct measurements of trees and approved

urban tree carbon models (“allometric equations”). Consult Annexes B, C, and D for detailed guidance on implementing the approaches.

Annex B covers how to design tree measurement programs (“inventories”), including required tree measurement data, and sampling techniques, design, and error. Annex C describes how to estimate tree carbon from tree measurement data using allometric equations and how to use these same equations to predict biomass when measurement data are not available. Annex D describes a calculation tool, the Center for Urban Forestry Research (CUFR) Tree Carbon Calculator (CTCC) that can also be used to estimate tree carbon.<sup>7</sup> The CTCC tool is based on well-developed urban tree allometric equations.

Approved Approaches for Quantifying Carbon Stocks:

1. Measure all trees in project tree sites during a single year at 10-year intervals. Use the measurement data with approved allometric equations (Annex C) or the CTCC (Annex D) to estimate carbon stocks. In the intervening years when you do not implement measurements, use approved methods to predict annual carbon stocks (Annex C or D). Such methods employ growth assumptions and allometric equations to estimate carbon stocks and are referred to below as growth models. Direct tree measurements or remote sensing techniques may be used. Data from direct tree measurements (i.e. tree diameter at breast height) can be input directly into approved allometric equations. Remote sensing can be used to estimate tree crown, from which tree diameter is inferred.
2. Measure all trees in project tree sites every 10 years using a rolling sample, which means a minimum of 10% of the tree sites are measured each year and after 10 years you have measured 100% of your tree sites (Annex B). Use the measurement data with approved allometric equations (Annex C) or the CTCC tool (Annex D) to estimate carbon stocks. For trees that are not measured in a given year, use approved methods (“growth models”) to predict annual changes in carbon stocks (Annex C). As described above in Approach 1, direct measurement or remote sensing techniques may be used to estimate tree carbon stock (Annex B). Remote sensing may also be used to identify project tree sites for sampling.
3. Measure a sample of trees in your project tree population each year (Annex B), use the measurement data with approved allometric equations or the CTCC tool to estimate carbon stocks in your samples (Annexes C and D), and extrapolate the carbon stock estimates to the entire tree population (Annex B). As described above in Approach 1, direct measurement or remote sensing techniques may be used to estimate tree carbon stock (Annex B). Remote sensing may also be used to identify project tree sites for sampling.

### **Requirements for Tree Monitoring and Acceptable Levels of Uncertainty**

A Tree Monitoring Plan must be included in the project submittal form (see Section 9 Reporting Parameters for details). The Tree Monitoring Plan must describe in detail the

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<sup>7</sup> The CTCC tool is currently in the final stages of development by CUFR. As soon as possible, it will be made available online (anticipated in Fall 2008).

approach the project plans to use to quantify carbon stocks. The document will serve as guidance for the project developer and will communicate the methodology to the verifier. The verifier will determine if the methodology is acceptable according to the verifier protocol. A verifier must approve the Tree Monitoring Plan before the project can begin reporting.

Approaches 1 and 2 both employ growth models where measurements that were performed in previous years are updated using growth models to estimate carbon stocks for a particular reporting date. For example, a tree measured five years previously will need to be 'grown' to estimate its carbon stocks in the current reporting year. When this approach is used, the estimate is considered as reliable as using a current tree measurement, provided the growth model used is approved (see Annex C and D), no measurement is 'grown' with a growth model for more than 12 years, and the growth assumptions are validated during the first five years of the project using actual tree measurements following the guidance below.

Actual tree growth may differ significantly from tree growth models. Therefore, it is important to quantify, assess, and fix differences at the beginning of the project through monitoring of actual tree growth. When using growth models, monitoring over the first five years of the project must be conducted to validate and, if necessary, calibrate growth models, such that carbon stock estimates from growth models do not differ by more than 10% from carbon stock estimates using tree measurements. Growth models must be validated and recalibrated every 10 years thereafter throughout the lifetime of the project.

Before using the approved growth models, consider contacting local arborists and other tree experts (e.g. local university extension offices, city tree managers) to evaluate the growth assumptions. Obtaining information on "typical" annual growth is important – whether a species normally grows 1 cm per year or 3 cm per year is helpful. If arborists can provide average annual growth (in diameter at breast height, "dbh") when trees are young, adolescent, middle-aged and senescent, these data can allow for further comparison with data produced by the CTCC.

Approach 3 involves statistical extrapolation from sample data. The sampling method must be stratified by like species and age classes (not to exceed groupings of five year age classes). The combinations of species and age classes create independent sampling populations, or strata. Appendix B provides further details on stratified sampling design.

The resulting estimates must meet a minimum confidence level of 90% to register all of the estimated carbon stocks. If the project sampling design results in lower levels of confidence, the carbon stock estimates will be discounted according to the guidance below. See Annex B for details on how to design a robust sampling program that will meet the desired level of confidence.

Descriptive statistics must be produced at the time of verification if a sampling methodology is incorporated. The estimate of carbon stock change in project trees is adjusted based on the level of confidence in the estimate according to the table below. The table provides sampling error ranges (where sampling error is on either side of the mean estimate at the 90% confidence level), calculated with the following equation.

Sampling Error (90% confidence interval) = (1 Standard Error \* 1.645)

Sampling Error*	Carbon Stock Change Adjustment (deduction by)
0 to 5%	0%
5.1 to 10%	10%
10.1 to 15%	20%
15.1 to 20%*	30%
> 20%	100%

\*Minimum Confidence Interval at 90% confidence limits.

In all three options, remote sensing techniques may be used to estimate tree carbon stocks using tree diameters inferred from tree crown measurements. Pre-approved regression equations must be used to convert tree crown diameter (or crown projection area) to tree diameter. The U.S. Forest Service Center for Urban Forestry Research (CUFR) is in the process of developing regression equations for common street tree species in each of 16 U.S. regions. When these become available, they can be used as pre-approved regression equations. Until then, the Reserve will not accept estimates based on remote sensing data.

## 5.2 Quantifying GHG emissions from motor vehicles related to tree planting and care

Vehicle emissions are those associated with transport of personnel, supplies, and trees to and from eligible project tree sites. The methods below are consistent with those provided in the California Registry General Reporting Protocol (GRP) for mobile combustion emissions.

1. Calculations of CO<sub>2</sub> emissions from vehicles are based on actual fuel use (gallons per year) and an emission factor (kg CO<sub>2</sub> per gallon) for fuel. The amount of fuel used for the eligible project trees can be estimated by prorating total fuel usage for all tree maintenance activities by the number of eligible project tree sites relative to total trees.

$$C_{\text{vehicle emis}} = (TC_g \times EF_g) + (TC_d \times EF_d)$$

where TC = total annual fuel consumption (gallons) of gasoline (TC<sub>g</sub>) or diesel fuel (TC<sub>d</sub>) and EF = fuel emission factor (EF<sub>g</sub> = 8.81 kg CO<sub>2</sub> per gallon of gasoline or EF<sub>d</sub> = 10.15 kg CO<sub>2</sub> per gallon of diesel fuel). Divide by 1,000 to convert kilograms into metric tons (t). See the GRP, Appendix Table C.4 for CO<sub>2</sub> emission factors for additional fuel types if applicable (e.g., biodiesel or ethanol).

2. Where actual fuel use (TG) is not available, it can be estimated using vehicle information (make, model, fuel type, and model years) and annual mileage estimates by vehicle type. Convert annual mileage to fuel consumption using EPA's fuel economy formula (see Eq. III.7b in the GRP).

### 5.3 Quantifying GHG emissions from equipment related to tree planting and care

Equipment emissions are associated with back hoes used in planting, and chain saws, aerial lifts, and chippers used during tree removal and pruning activities.

1. If the total amount of fuel consumed by equipment on GHG project-related activities is known, CO<sub>2</sub> emissions can be calculated using fuel-specific emission factors as above.

$$C_{\text{equip emis}} = (TC_g \times EF_g) + (TC_d \times EF_d)$$

2. In many cases, however, equipment use is tracked in hours. If the hours are known, the emissions can be calculated for each piece of equipment based on the following formula and then summed:

$$C_{\text{equip emis}} = \text{HRS} \times \text{LF} \times \text{HP} \times \text{EF}$$

where HRS = hours used, LF = typical load factor, HP = maximum horsepower and EF = average CO<sub>2</sub> emissions per unit of use (kg/hr). Typical load factors, horse power, average emissions, and EFs for equipment are given in Table 1. Typical hours required for pruning and removal activities are given for maintenance equipment in Table 2.

**Table 1.** Typical load factors (LF) and average CO<sub>2</sub> emissions (EF) for different maintenance equipment.

Equipment	LF <sup>a</sup>	EF (kg/hp/hr) <sup>b</sup>	EF
Aerial lift (45 hp)	0.505	0.783	0.568
Backhoe	0.465	0.775	0.568
Chain saw (2 hp)	0.500	0.429	0.568
Chain saw (7 hp)	0.500	0.429	0.568
Chipper (50 hp)	0.370	0.783	0.568

<sup>a</sup> Nowak et al. 2002

<sup>b</sup> CARB 2008

**Table 2.** Total hours of equipment run-time by dbh classes (inches) for tree pruning and removal (from ACRT data as cited by Nowak et al. 2002). Assumes crews work efficiently and equipment is not run idle.

dbh	Pruning				Removal				
	2.3-hp saw	3.7-hp saw	Bucket truck <sup>a</sup>	Chipper <sup>b</sup>	2.3-hp saw	3.7-hp saw	7.5-hp saw	Bucket truck	Chipper
1-6	0.05	NA	NA	0.05	0.3	NA	NA	0.2	0.1
7-12	0.1	NA	0.2	0.1	0.3	0.2	NA	0.4	0.25
13-18	0.2	NA	0.5	0.2	0.5	0.5	0.1	0.75	0.4
19-24	0.5	NA	1.0	0.3	1.5	1.0	0.5	2.2	0.75
25-30	1.0	NA	2.0	0.35	1.8	1.5	0.8	3.0	1.0
31-36	1.5	0.2	3.0	0.4	2.2	1.8	1.0	5.5	2.0
36+	1.5	0.2	4.0	0.4	2.2	2.3	1.5	7.5	2.5

<sup>a</sup> Mean HP = 43 (U.S. EPA 1991)

<sup>b</sup> Mean HP = 99 (U.S. EPA 1991)

If in planning for an urban tree project, a project developer wishes to forecast emissions from vehicles and equipment used in tree planting a value of 2.62 kg CO<sub>2</sub> per project tree per year (McPherson and Simpson 1999) can be used. Divide by 1,000 to convert kilograms into metric tons (t). Projected values are not used to determine annual project GHG reductions, but may be useful for project planning and development.

## 6 Permanence

GHG projects involving biological carbon sequestration must address the potential reversibility of sequestered carbon, or more precisely the loss of stored carbon after carbon benefits have been reported, verified, and registered. Consistent with guidance from the Intergovernmental Panel on Climate Change, California Registry's underlying standard for permanence is a minimum of 100 years—the biological carbon should remain stored for 100 years (e.g. a reduction of carbon created in 2008 will remain stored until 2108 and if it is reversed, e.g. through mortality, then it must be replaced).

California Registry expects project developers to take steps to maximize the likelihood that the carbon gains of urban forestry projects are preserved for this period of time or longer. To this end, the following are requirements of this protocol:

- Continuous annual reporting of carbon stocks for a project lifetime of 100 years.
- Continuous replacement of dead trees at all tree sites during the project lifetime (i.e. projects must have an average net tree gain of no less than zero). Each tree site may have one or more replacement trees. Also, the location of some GHG tree project sites may change due to disturbances that unexpectedly eliminate tree sites. It is the developer's responsibility to promptly locate and plant replacement sites so that there is no reduction in the total number of treed project sites.
- If reversals are not compensated for with replacement trees, they will have to be compensated for using another approved mechanism. California Registry is developing flexible mechanisms to address reversals that will apply to all forest GHG protocols including this one.

### Guidance to Understanding Risks of Reversals

To further assist project developers in identifying and minimizing risks of reversals, following is guidance to understanding risks of reversal.

**Disturbance Potential:** There are three main types of disturbances that influence the risk of future reversibility: land use change, human disturbance, and natural disturbance. Project developers should identify the potential risk each type of disturbance poses to their GHG tree project. Land use change refers to the likelihood of future changes in land use that threaten tree survival, such as zoning changes to more intensive land uses, new development, infill or redevelopment, and reconfiguration of transportation corridors. The risk of land use change will be least when tree planting sites are in easements guaranteed to remain undisturbed in perpetuity. The risk of land use change will be highest when tree sites are located in areas zoned or planned for future development and redevelopment.

Human disturbance potential concerns human-induced change resulting in tree mortality after carbon reductions have been certified. Human disturbance potential is defined as threats to tree survival that are not related to land use change. Examples include

changes in management (e.g. ending irrigation and pest/disease treatment), increased vandalism, and changes in levels of air and soil pollutants or soil moisture. Human disturbance potential is least when tree species are tolerant of the most likely threats and the threats are relatively few and benign. Human disturbance potential is greatest when the tree species are intolerant of future stressors and those threats have potential to decimate large numbers of project trees.

Natural disturbance potential refers to threats to tree survival associated with non-human causes, such as disease, fire, drought, cold, ice/snow, wind/hurricane, flooding, earthquake, landslide, and volcano. The frequency (return interval) and severity of each type of natural disturbance influence its risk to the GHG project tree population. For example, tree sites within a 10-year flood plain will be at higher risk than sites outside this risk zone. In assessing risk, consider the relative tolerance of the tree species to the natural disturbances most likely to occur at the tree sites.

These risks of reversibility should be carefully assessed and addressed in the Initial Project Report. Locating tree sites and selecting species that minimize the risk of loss from disturbance will increase the project's long-term success. Measures taken to reduce the risk of tree loss due to disturbances should be explained.

**Project Resources:** California Registry encourages project developers to describe project resources that improve its robustness. Examples of project resources include management capacity, financial capacity, future income, project endorsement, and proven technologies/practices. Project developers should ensure that long-term maintenance and tree care programs are in place, proper organizational and/or legal frameworks exist to support project activity, and sufficient financial resources are present to support the project and provide for monitoring.

**Project Activities:** Project developers should also include as part of their permanence reporting a description of activities taken to promote establishment, vigorous growth, and longevity of project trees. Examples include purchasing trees grown to quality standards, providing effective training in tree care practices, enforcing ordinances to protect project trees, and implementing tree care agreements.

## 7 Co-Benefits and Negative Impacts

Urban trees may have GHG benefits in addition to those from sequestration. Trees planted strategically to reduce energy use will effect reductions in GHG emissions at the power plant. Tree residue used as fuel in bioenergy plants may effect reductions in GHG emissions if the trees are used to replace fossil fuel sources, such as coal. Specific guidance is provided in Annex F for estimating these indirect GHG emissions reductions from energy conservation and bioenergy production. Reporting of these and other co-benefits of GHG tree projects is optional.

Tree planting and stewardship activities can provide other co-benefits. They can involve conservation education, neighborhood revitalization, job training, controlling stormwater runoff, improving air and water quality, conserving water, and recycling green waste. U.S. Forest Service research indicates that when the economic value of benefits trees produce is assessed, total benefits can be two to six times greater than costs for tree planting and care (McPherson et al. 2005). Furthermore, many of these benefits extend beyond the site where a tree grows, to influence quality of life in the local neighborhood,

community, and region. The value of the services provided by GHG project trees is likely to increase as the trees mature.

Urban forestry projects may have unintended consequences that adversely impact other efforts to promote sustainability and quality of life. Care should be taken during the project planning phase to identify and mitigate any potential negative impacts (i.e., choose appropriate tree species). Potential negative impacts could include: impacts on urban forest biological diversity (a variety of tree species should be planted to avoid a monoculture); threats from invasive plants/pests/disease; water resources – conservation and runoff management; air quality – net effects on air quality (biogenic volatile organic compounds, aeroallergens); infrastructure – root conflicts with sidewalks and curb & gutter, trees in power lines, visibility of signage, add to sanitation and solid waste stream, etc.; energy – attenuate solar access to dedicated solar systems. It is important to document these potential impacts and the measures taken by the project to avoid or mitigate such impacts.

## 8 Project Monitoring

Project developers are responsible for monitoring the performance of the project and maintaining records of monitoring data in accordance with the requirements stipulated in Section 1.9 Reporting Parameters. Monitoring requirements are divided into these categories:

- Tree Maintenance Plan,
- Tree Monitoring Plan, and
- GHG Emissions and Sequestration Activity Data.

The Tree Maintenance Plan is used to assess the potential of activity-shifting leakage and other aspects of project performance. The Tree Monitoring Plan and GHG Emissions and Sequestration Activity Data are used to verify GHG emissions and sequestration estimates.

### 8.1 Tree Planting, Maintenance, and Levels of Service

Reporting planting and maintenance activities and expenditures is critical to assessing leakage and GHG tree project compliance. At the entity level, by comparing reported annual tree care expenditures for different years one can assess if a boost in project activity coincides with a drop in the level of care non-project trees are receiving (i.e. activity-shifting leakage may be present). At the project level, information about tree maintenance and expenditures helps assess the strength of the project and its likelihood of success. To standardize annual reporting of tree planting and maintenance operations, activities are grouped into five program areas: tree planting, small tree care (< 6 inch dbh), large tree care (> 6 inch dbh), tree removal, and administration/other (e.g. clerical, training, outreach). Annual expenditures and the level of service provided are indicators for each program area. Level of service is a quantifiable measure of tree care activities performed during a year. Higher levels of service indicate greater amounts of work performed. Reporting entities must provide a tree maintenance plan (TMP) that describes entity-level expenditures for a 10- to 20-year period and project level activities for the reporting period.

Below are the specific TMP requirements. All information is for GHG project activities and expenditures, except where noted. In some cases, information about the entity is

also required to assess leakage potential. This is denoted with “separately for the project and entity” in parentheses. Otherwise the information pertains to the project only.

Note that project developers must estimate the anticipated annual levels and expenditures for each of the criterion below in the Project Submittal Form and maintain records on actual levels and expenditures each year for the project lifetime.

Tree planting:

- Number, species, size, and location\* of trees planted in new tree sites each year,
- Number, species, size, and location\* of replacement trees planted each year,
- Number and location\* of relocated tree sites each year,
- Reasons for relocations and, if applicable, modifications made to the project to reduce the chance of future relocations,
- Project tree resource: percentage of total program tree sites now planted,
- Annual expenditure (separately for the project and entity).
- Small tree care
  - Number of small trees inspected/pruned each year,
  - Inspection/pruning cycle (total number of trees / number treated per year),
  - Annual expenditure (separately for the project and entity).
- Large tree care
  - Number of large trees inspected/pruned each year,
  - Inspection/pruning cycle (total number of trees / number treated per year),
  - Annual expenditure (separately for the project and entity).
- Tree removal
  - Number, species, size, and location\* of trees removed each year,
  - Reasons for removals and, if applicable, modifications made to the project to reduce the chance of future removals,
  - Removal cycle (total number of trees to remove / number removed per year),
  - Annual expenditure (separately for the project and entity).
- Administration/other
  - Average \$/tree site expenditure (total \$ on admin and other / total tree numbers),
  - Annual expenditure (separately for the project and entity).

\*GPS coordinates must be taken on all project tree sites. Tree site location can be designated on a map of the project physical boundaries (see Section 9.1 Project Submittal Form for details).

If the potential for leakage is determined, then additional information on entity-level tree planting activities may be requested by the verifier.

## 8.2 Tree Monitoring Plan

A Tree Monitoring Plan is important for several reasons. The plan provides sufficient and transparent information on tree measurement and monitoring. This information is used to ensure the quantification methods meet the standards of this protocol. In addition, the

plan informs the project about the status of trees sites, helping to ensure that lost trees are replaced and risks of reversals are minimized.

- Indicate the choice of method from the three options in section 5.1.
- Detailed description of procedures to census, measure, and report information on the project trees, including the survey method (ground survey or remote sensing), sample sizes, and method for choosing samples.
- Methods used to measure and record tree size and growth.
- Methods used and information collected on tree survival and health.
- Growth assumptions, if applicable.
- Description of data used to validate growth assumptions, if applicable.
- Modifications made to improve growth assumptions, if applicable.
- Statistical methods used to extrapolate sample data to the total project tree population, if applicable.
- Estimated sampling error, if applicable.

### **8.3 GHG Emissions and Sequestration Activity Data**

The data below are needed inputs for estimating project GHG reductions. Transparent reporting of this information enables verification.

- Data on the species, size, date, and location of measured trees,
- Specific equations used to calculate carbon storage, or specify if CTCC model was used,
- Annual amount and type of fuel used by tree planting and care vehicles (or the vehicle miles traveled and average fuel economy), and
- Annual amount and type of fuel used in tree maintenance equipment (or the number of hours equipment is used that year).

## **9 Reporting Parameters**

This section provides guidance on reporting rules and procedures. A priority of California Registry is to facilitate consistent and transparent information disclosure among project developers.

Before registering reductions associated with urban forestry GHG projects, project developers prepare a Project Submittal Form to list a project. Then, project developers submit annual project reports through California Registry's online registration software, the Climate Action Reserve in which annual carbon sequestration in project trees and vehicle and equipment GHG emissions related to tree planning and care are reported.

### **9.1 Project Submittal Form**

The following information will be requested in the Project Submittal Form.

General background information on the entity, partner (if applicable), and project:

1. Name of the project developer (reporter).
2. Name and legal standing of the entity.
3. Name of partner organization/person (if applicable).
4. Project start date.
5. Date of the initial reporting year.
6. Project lifetime: must be 100 years.

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## 7. Location of the project

### Project Summary:

1. State the GHG tree project's goals.
2. Describe any general guidelines that will inform project development and execution.
3. Person or Entity who is chiefly responsible for planning, implementation, and reporting of project activity. List and explain the involvement of partners, if applicable.
4. Provide documentation describing how ownership of GHG reductions will be determined.
5. Briefly describe implementation of the project. Include information on the number of project tree sites and trees that will be planted (including replacements), types of species, and where they will be planted, tree stewardship and monitoring plans. *Some of this information is also requested in the TMP described below.*
6. Confirm that the trees will be planted in maintained landscapes and spaced at least 5 m (16 ft) apart so as to be open growing.

### Project Boundaries:

1. Describe and/or include a map of the physical boundary of the project, including anticipated tree sites, an outline of the entity boundary, and tree care facilities (location where vehicles and equipment are housed).
2. List the mandatory and optional GHG emissions sources and sinks that will be included in the GHG Assessment Boundary

### Project Eligibility: Project Performance and Regulatory Screen:

1. Expected average annual number of project tree sites created over the project lifetime (same as project NTG).
2. Entity average annual NTG prior to the start of the project (municipalities and educational campuses).
3. Total number of entity trees prior to the start of the project (municipalities and educational campuses).
4. Number of residential customers prior to the start of the project (utilities).
5. Describe tree planting requirements mandated by law and planned to be undertaken by the entity.

### Description of Risk of Reversals:

1. Describe the chief threats to GHG project tree survival due to land use changes, and human and natural disturbances. Describe the measures that will be taken to mitigate and adapt to these threats.
2. Explain how factors such as management capacity, financial capacity, project endorsement, and proven technologies/practices will enhance the project's ability to ensure a 100 year standard for carbon sequestration.
3. Describe activities that will be taken to promote establishment, vigorous growth, and longevity of project trees, such as requirements for quality stock, mechanisms to ensure adequate training for planting and care, tree protection ordinances, and tree care agreements.

### Co-benefits and Negative Impacts:

1. Describe anticipated co-benefits and specify which if any will be quantified annually.

2. Describe measures that will be taken to prevent and mitigate potentially adverse impacts.

Tree Maintenance Plan:

1. Document anticipated levels of service and expenditures for all criteria in the Tree Maintenance Plan (Section 8 Project Monitoring for details).
2. Describe how planting sites will be identified and prioritized. Describe any guidance, performance requirements, or specifications related to quality of nursery stock, planting details, training for tree planters, and initial staking, mulching, watering.
3. Provide estimates of tree mortality rates for newly planted and established project trees and explain how these numbers were established.
4. Describe how project trees that need replacing will be identified, how quickly they will be replaced, and size and species of replacement trees.
5. Identify the personnel who will implement and manage the project, their roles and responsibilities, and funds required for salary, operations, training, and overhead over the lifetime of the project. Other activities that may be included here are public relations, accounting, fund raising, and outreach.
6. Please explain if:
  - a. You expect that the annual expenditures that non-project trees receive will decrease as a result of the GHG tree project.
  - b. You expect your organization's expenditures on non-project tree planting, maintenance, and removal will change as a result of the project.

*Tree Monitoring Plan*

Provide a detailed description of:

- Method (chosen from the three options in section 5.1).
- Procedures that will be used to census, measure, and report information on the project trees, including the survey method (ground survey or remote sensing), sample sizes, and method for choosing samples.
- Methods that will be used to measure and record tree size and growth.
- Methods that will be used and information collected on tree survival and health.
- Growth assumptions that will be use, if applicable; and information supporting the choice of assumptions.
- Description of plans to validate growth assumptions, if applicable.
- Statistical methods that will be used to extrapolate sample data to the total project tree population, if applicable.
- Estimated sampling error, if applicable.

## 9.2 Record Keeping

For the purposes of independent verification and historical documentation, project developers are required to keep all information outlined in this protocol for a minimum of seven (7) years post project verification.

## 9.3 Reporting cycle

For the purposes of this protocol, project developers report GHG reductions associated with planned tree planting activities that occurred the preceding year. In keeping with the reporting rules of California Registry's General Reporting Protocol, the reporting

deadline for project developers is June 30 the year following the reduction year, and the verification deadline is October 31.

#### **9.4 Project crediting period**

Project developers are eligible to register GHG reductions with California Registry according to this protocol for a period of 100 years.

#### **9.5 Non-California Climate Action Registry reporting**

California Registry requires that project developers only register reductions from GHG reduction projects with one registry. Upon submittal of verified GHG reductions to California Registry, project developers are required to provide a signed attestation to California Registry stating that the GHG reductions being registered are not being registered elsewhere. If California Registry determines that duplicative emissions reductions registration has occurred, registration of the project will be cancelled and the project developer precluded from registering any other projects.

## 10 Glossary of Terms

Activity-shifting leakage	Shifting of activities or resources from other parts of the entity to the project, causing unanticipated increases in GHG emissions outside the project boundary.
Additionality	Greenhouse gas emission reductions should occur as a result of specific GHG mitigation incentives; additionality is achieved when GHG reductions are beyond what would occur under “business as usual.”
Baseline	An estimate of GHG emissions and removals that would have occurred under business as usual.
Biomass	The amount of living matter comprising, in this case, a tree.
Carbon pool	A reservoir that has the ability to accumulate and store carbon or release carbon. In the case of forests, a carbon pool is the forest biomass, which can be subdivided into smaller pools. These pools may include above-ground or belowground biomass or roots, litter, soil, bole, branches and leaves, among others.
Carbon Reduction Tons (CRT)	One metric ton of verified CO <sub>2</sub> equivalent emission reduction or sequestration (pronounced “carrot”).
Carbon stock	A pool of stored carbon. Forest carbon stocks include living and standing dead vegetation, woody debris and litter, organic matter in the soil, and harvested stocks such as wood for wood products and fuel.
Carbon stock change or Carbon sequestration	The annual incremental change in carbon stocks.
C <sub>emis</sub>	CO <sub>2</sub> and other greenhouse gases from project tree-care-related emissions, for example, due to vehicular or equipment use.
C <sub>proj</sub>	Project carbon, i.e. carbon stored annually in project trees, reported as CO <sub>2</sub> .
Direct emissions	Greenhouse gas emissions from sources that are owned or controlled by the reporting entity, e.g. diesel or gasoline use for tree maintenance on city trees by the municipal arborists.
Dry weight (DW) biomass	The weight of aboveground tree biomass when dried to 0% moisture content. Also known as oven-dry and bone-dry biomass. Convert from green biomass to dry weight biomass by multiplying by 0.56 for hardwoods or 0.48 for softwoods.
Entity	The municipality, educational campus, or utility that owns, controls, or manages urban trees, within which project trees are planted.
Freshweight or green biomass	The weight of aboveground tree biomass when fresh (or green), which includes the moisture present at the time the tree was cut.

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	The moisture content of green timber varies greatly among different species. We assume that the moisture content of freshweight biomass is 30%.
Global warming potential (GWP)	Factors used to convert emissions from GHGs other than carbon dioxide to their equivalent carbon dioxide emissions.
Greenhouse gases (GHG)	Any of the gases whose absorption of solar radiation is responsible for the greenhouse effect. Greenhouse gases covered by California's Global Warming Solutions Act (AB 32) are carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.
Indirect emissions	GHG emissions that are consequence of the reporting company's operations but occur at sources owned or controlled by another company (Source: WRI).
Inherent uncertainty	The scientific uncertainty associated with calculating carbon stocks and greenhouse gas emissions.
Leakage	According to the International Panel on Climate Change: "the unanticipated decrease or increase in greenhouse gas benefits outside of the project's accounting boundary as a result of project activities."
Net tree gain (NTG)	Number of trees planted minus the number removed annually. NTG can be measured at the entity or project level.
Performance standard	Use a common reference for "performance" (GHG emissions or other specific actions) to assess GHG project performance. Performance is based on an analysis of a relevant sector across a range of geographic regions. Performance standards can be used to assess additionality whereby a pre-determined threshold represents performance that is better than business as usual and GHG projects must exceed the threshold.
Performance threshold	A level of emissions performance (measured in absolute emissions rates, or based on market penetration for a given technology, or implementation of a technology standard or management practice) that is better than the average emissions performance for delivery of the same services or outputs.
Project activity	The carbon storage, emission reductions and emissions due to a GHG tree project.
Project developer	The person, company, or organization developing a GHG project.
Project tree site	A tree site that is planted and maintained in tree canopy cover as a result of project activity.
Reporting uncertainty	The level of uncertainty associated with an entity's chosen method of sampling and/or inventorying carbon stock and calculation methodologies. Contrast with inherent uncertainty.
Reporting year	The year for which an entity is reporting its project activity.

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Sequestration	The process by which trees remove carbon dioxide from the atmosphere and transform it into biomass.
Tree maintenance plan (TMP)	Describes annual tree maintenance levels of service and associated expenditures.
Tree residue	Aboveground biomass from urban trees (as distinguished from construction debris) that can be salvaged for reuse, such as mulch, wood products, or fuel for biomass power plant.
Tree resource	All trees planted and maintained by an entity.
Verification	The process by which California Registry accredited third party verification firms independently review records, data, equipment, and activities to ensure compliance with the eligibility requirements and calculation methodologies laid out by California Registry's project protocols. Verifiers determine the number of GHG emission reductions attributable to the project.

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