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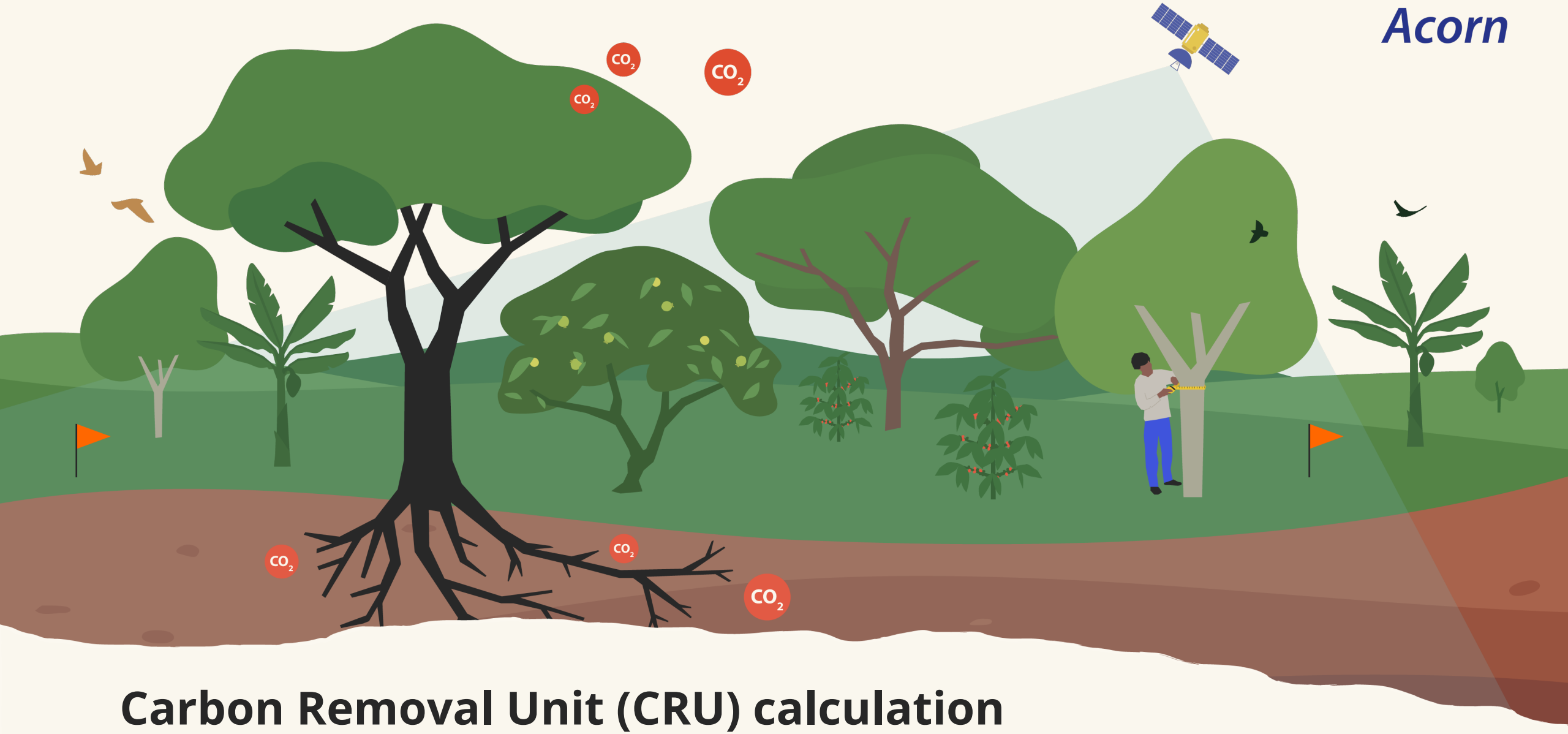

Carbon Removal Unit (CRU) calculation

A visual guide to understanding the Acorn Framework & Methodology 2.0

Carbon Removal Unit (CRU) calculation

Our Acorn program measures carbon stored in biomass, such as trees and shrubs, which is converted to Carbon Removal Units (CRUs). Each CRU represents a metric ton (or 1000 kg) of carbon dioxide equivalent (t CO_2e) removed from the atmosphere. To calculate this as accurately as possible, we use the equation below.

$$\mathbf{CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)}$$

The formula is the same for all plots, but this guide will explain 6 different factors that impact your CRU calculation.

- Biomass delta ($AGB_{\Delta,y} + BGB_{\Delta,y}$)
- Root:shoot ratio ($BGB_{\Delta,y} = AGB_{\Delta,y} \cdot R$)
- Adjustment factor for leakage (AdjL)
- Adjustment factor for pre-existing biomass (AdjB)
- Adjustment factor for uncertainty (AdjU)
- Buffer pool (BP)

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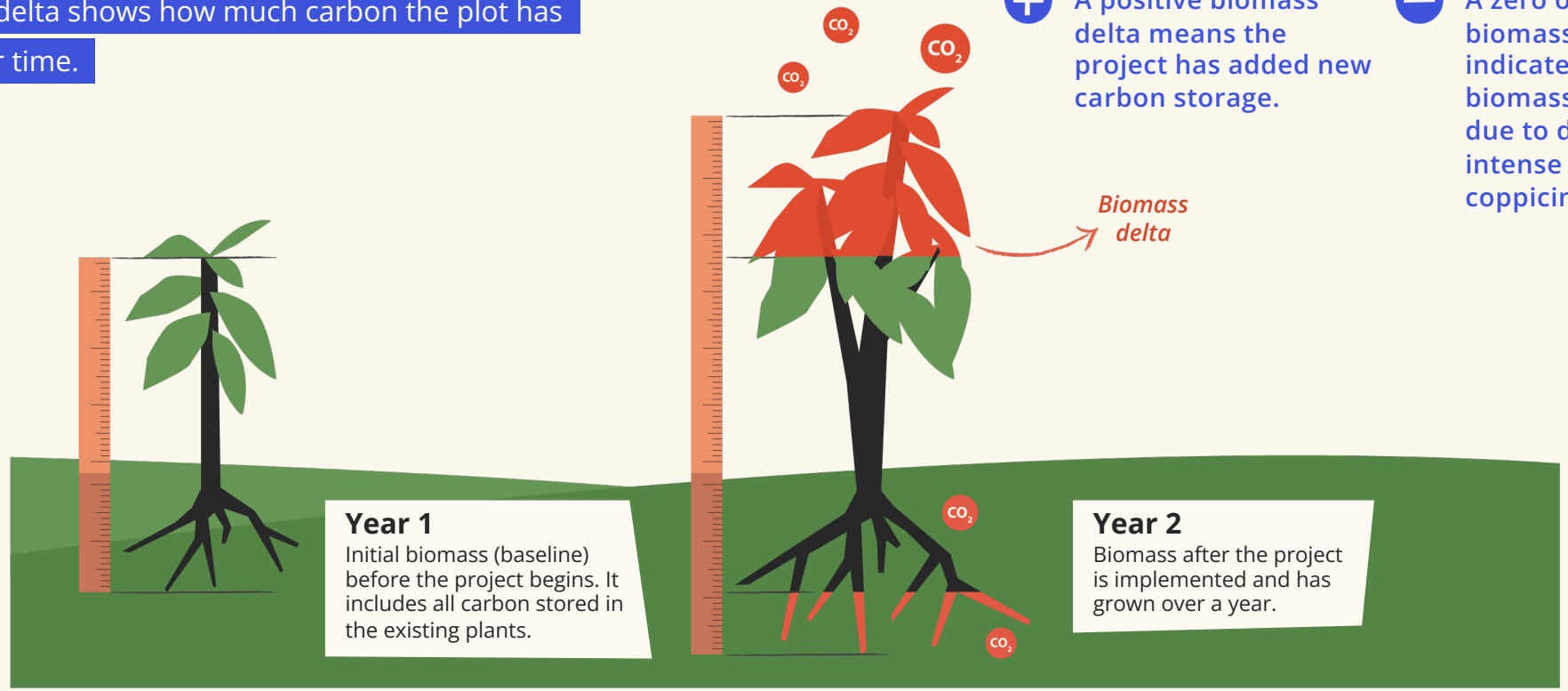
Frequency: Every measurement
Scale: Plot level

Biomass delta

'Biomass' is the organic matter you see above ground (e.g. a tree and its trunk, leaves, branches) and the matter you don't see below ground (e.g. roots). The **'biomass delta'** is the difference between the biomass at two different points in time (e.g. Year 1 and Year 2).

The biomass delta shows how much carbon the plot has captured over time.



A positive biomass delta means the project has added new carbon storage.

A zero or negative biomass delta indicates no growth or biomass loss, likely due to deforestation, intense pruning, or coppicing.

$CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)$

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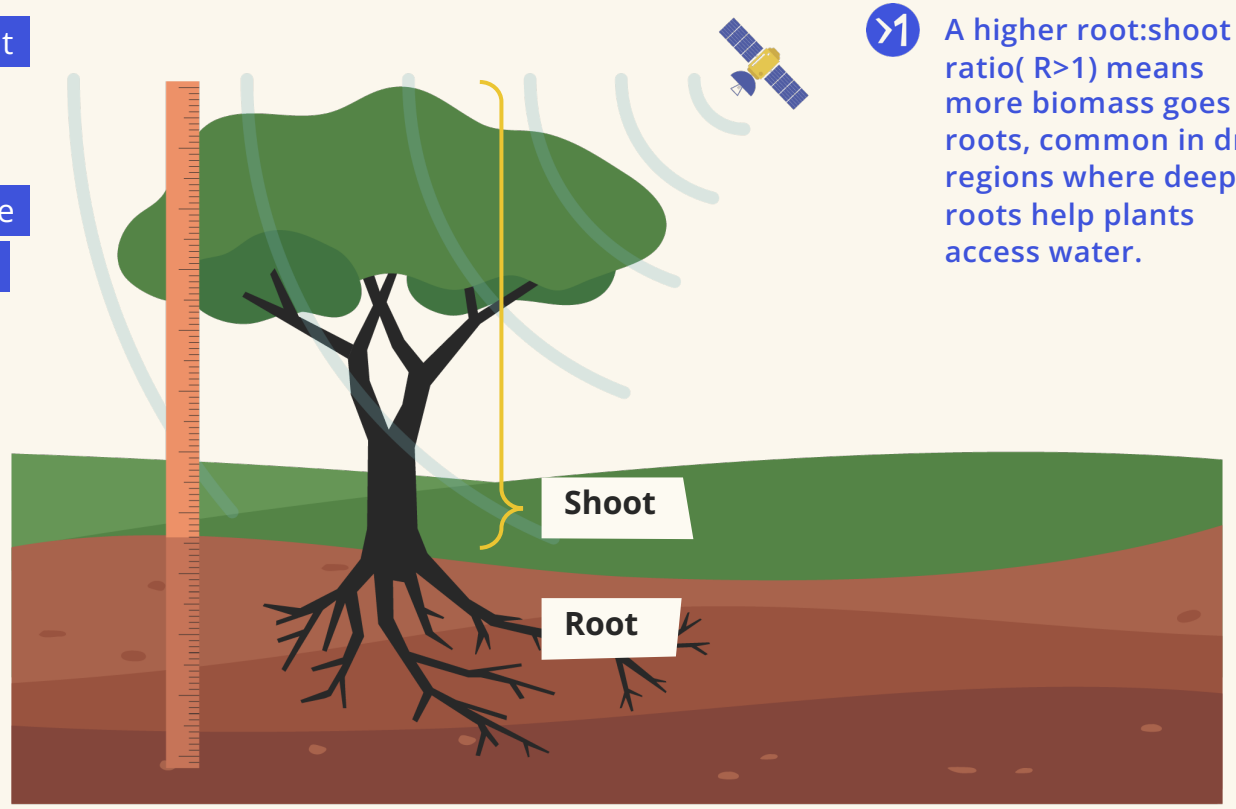
Frequency: Once (IPCC ratio)
Scale: Ecoregion level (IPCC)

Root:shoot ratio

'Root' refers to the belowground biomass (BGB). **'Shoot'** refers to the aboveground biomass (AGB), e.g. the tree trunk, branches, and leaves. The **'root:shoot ratio'** is the relationship between the 'root' and 'shoot,' allowing us to estimate the unseen belowground biomass. This helps us calculate the biomass delta more accurately.

Roots store a significant amount of carbon, so ignoring them would underestimate your project's total CRUs. To calculate the belowground biomass, we measure the aboveground biomass through remote sensing techniques, which is then multiplied by the root:shoot ratio.



>1 A higher root:shoot ratio(R>1) means more biomass goes to roots, common in dry regions where deep roots help plants access water.

<1 A lower root:shoot ratio (R<1) means more biomass goes to shoots, common in fertile regions where aboveground growth is prioritized.

$BGB_{\Delta,y} = AGB_{\Delta,y} \cdot R$

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Frequency: Every 5 years
Scale: Project level

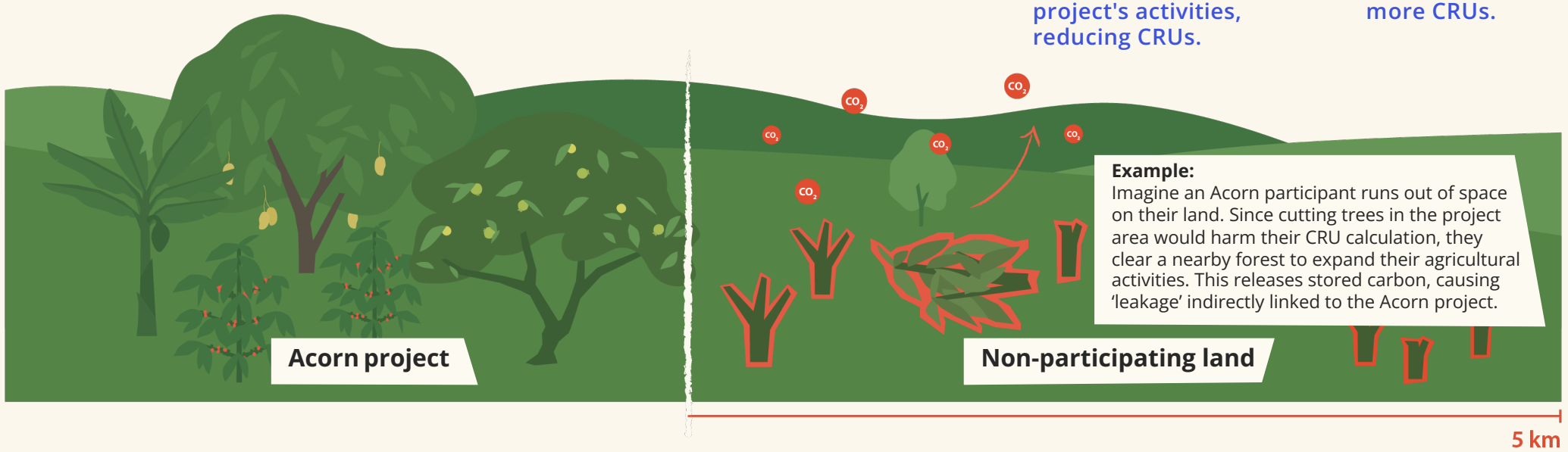
Adjustment factor for leakage

'Leakage' refers to the unintended loss of stored carbon or an increase in CO_2e emissions as a side effect of an Acorn project activity. The adjustment factor for leakage accounts for any potential leakage within 5 km of your project area.

Our Acorn program must also account for the possibility that carbon may be released outside the project area, as an unintended side effect of the project.

A higher factor for leakage means more carbon loss or emissions occurred outside the project boundaries due to the project's activities, reducing CRUs.

A lower factor for leakage means minimal carbon loss or emissions occurred, allowing the project to retain more CRUs.



Example:
Imagine an Acorn participant runs out of space on their land. Since cutting trees in the project area would harm their CRU calculation, they clear a nearby forest to expand their agricultural activities. This releases stored carbon, causing 'leakage' indirectly linked to the Acorn project.

$CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)$

Source: AM 006

Acorn

Frequency: Annually or with design changes
Scale: Project level

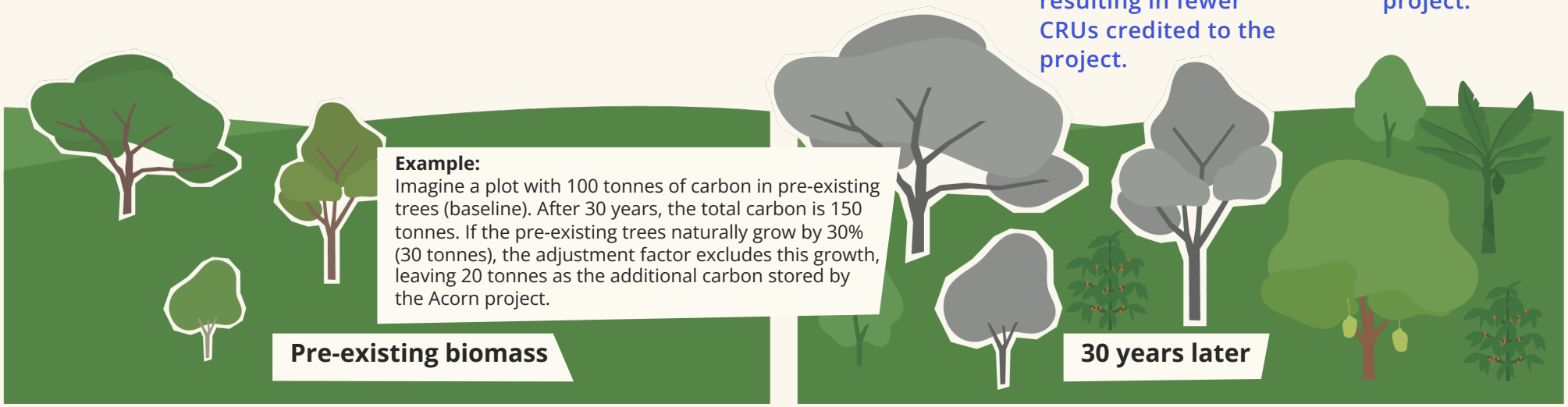
Adjustment factor for pre-existing biomass

Our program must account for pre-existing biomass, as carbon is already stored in trees, plants, and roots before the Acorn project began. This ensures better accuracy and credibility in carbon accounting.

By calculating pre-existing biomass, Acorn is able to exclude carbon stored before the Acorn project activity began.

A higher factor for pre-existing biomass indicates that most carbon comes from biomass that existed before the Acorn project period, resulting in fewer CRUs credited to the project.

A lower factor for pre-existing biomass means most carbon comes from new vegetation, leading to more CRUs credited to the project.



$CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)$

Source: AM 005

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Adjustment factor for uncertainty

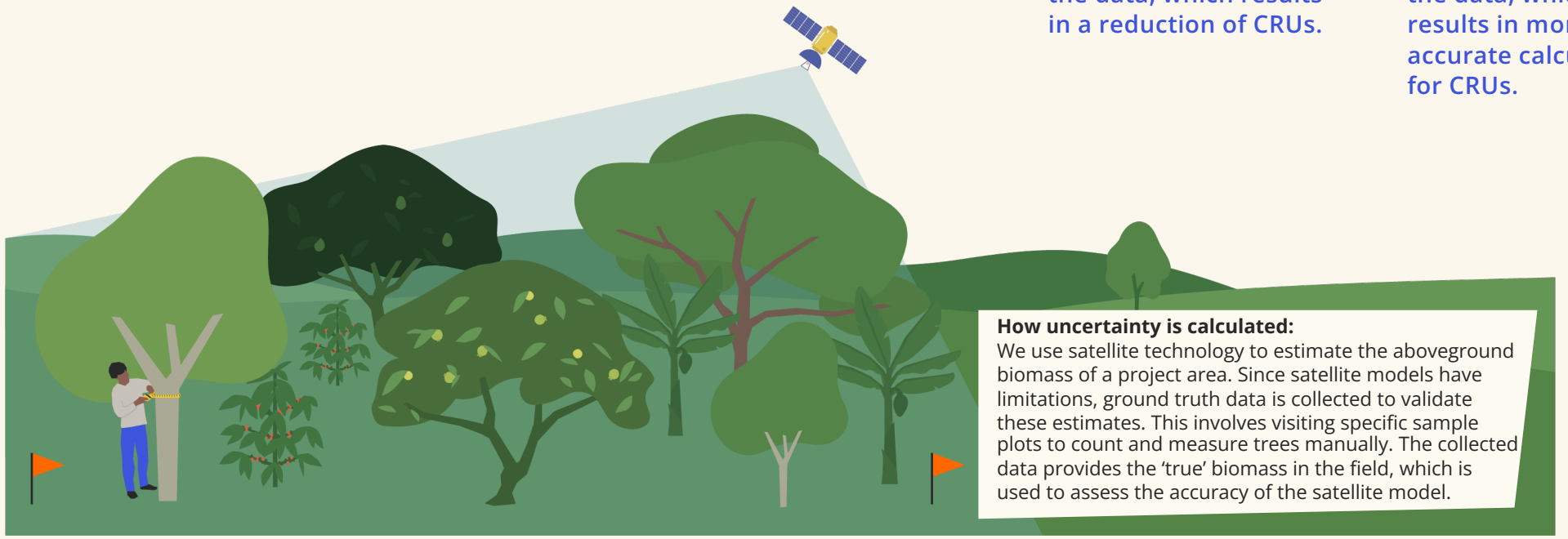
Frequency: Every measurement
Scale: Project level

Our models are reliable in calculating biomass growth, but they are not 100% bulletproof. This adjustment factor ensures that any variability or inaccuracies in biomass estimates are accounted for, providing a conservative and reliable calculation of CRUs.

By applying this factor, we reduce the risk of overestimating CRUs.

A higher factor for uncertainty indicates greater variability in the data, which results in a reduction of CRUs.

A lower factor for uncertainty indicates greater confidence in the data, which results in more accurate calculations for CRUs.



How uncertainty is calculated:
We use satellite technology to estimate the aboveground biomass of a project area. Since satellite models have limitations, ground truth data is collected to validate these estimates. This involves visiting specific sample plots to count and measure trees manually. The collected data provides the 'true' biomass in the field, which is used to assess the accuracy of the satellite model.

$CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)$

Source: AM 007

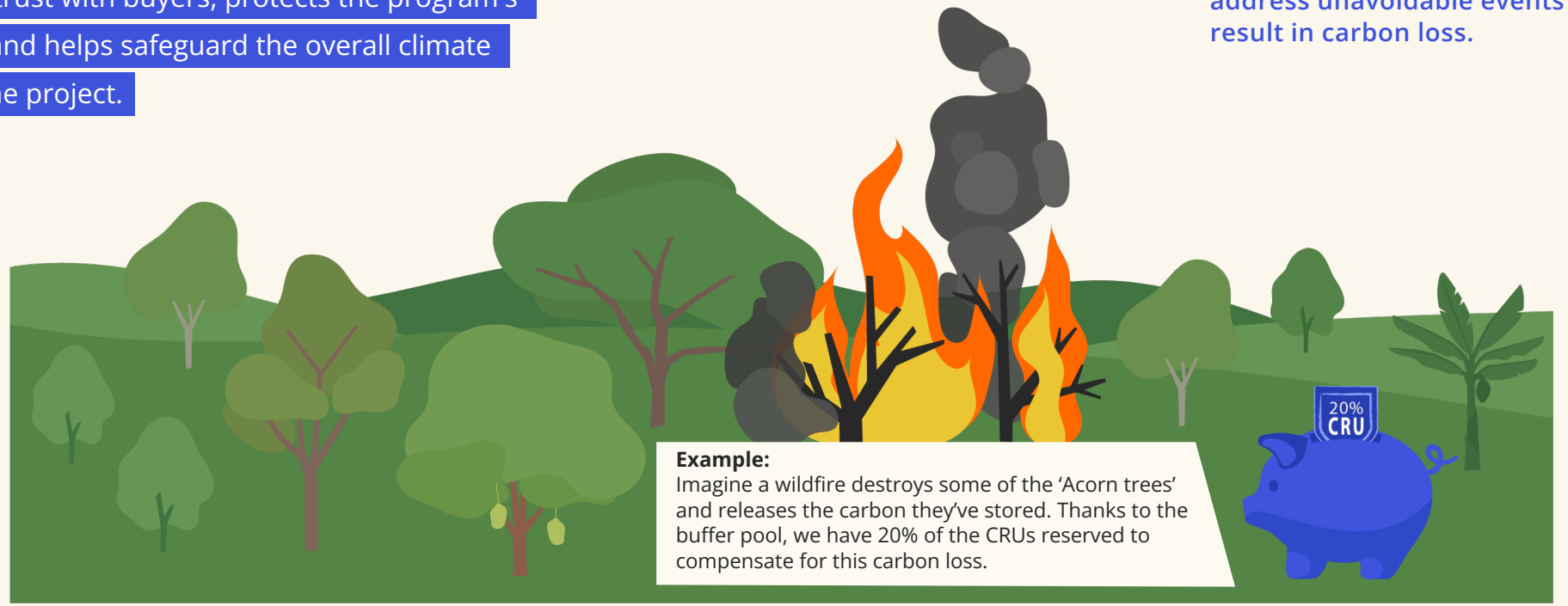
Buffer pool

Frequency: Fixed (20% in Framework 2.0, 15% in Framework 1.0)

The buffer pool is a necessary risk management tool for small-scale agroforestry carbon projects. For example, if a natural disaster occurs, the buffer pool compensates for the stored carbon that was released back into the atmosphere. 20% of your total CRUs is set aside as a reserve in case of unavoidable events.

The buffer pool helps to ensure the integrity of CRUs. This builds trust with buyers, protects the program's credibility, and helps safeguard the overall climate impact of the project.

The buffer pool reserves 20% of the total CRUs from your project to address unavoidable events that result in carbon loss.



Example:
Imagine a wildfire destroys some of the 'Acorn trees' and releases the carbon they've stored. Thanks to the buffer pool, we have 20% of the CRUs reserved to compensate for this carbon loss.

$$CRU = ((((AGB_{\Delta,y} + BGB_{\Delta,y}) \cdot CF - AdjL) \cdot (1 - AdjB) \cdot (1 - AdjU) \cdot C) - (LE_{\Delta,y})) \cdot (1 - BP)$$

Source: Acorn Framework 2.0

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