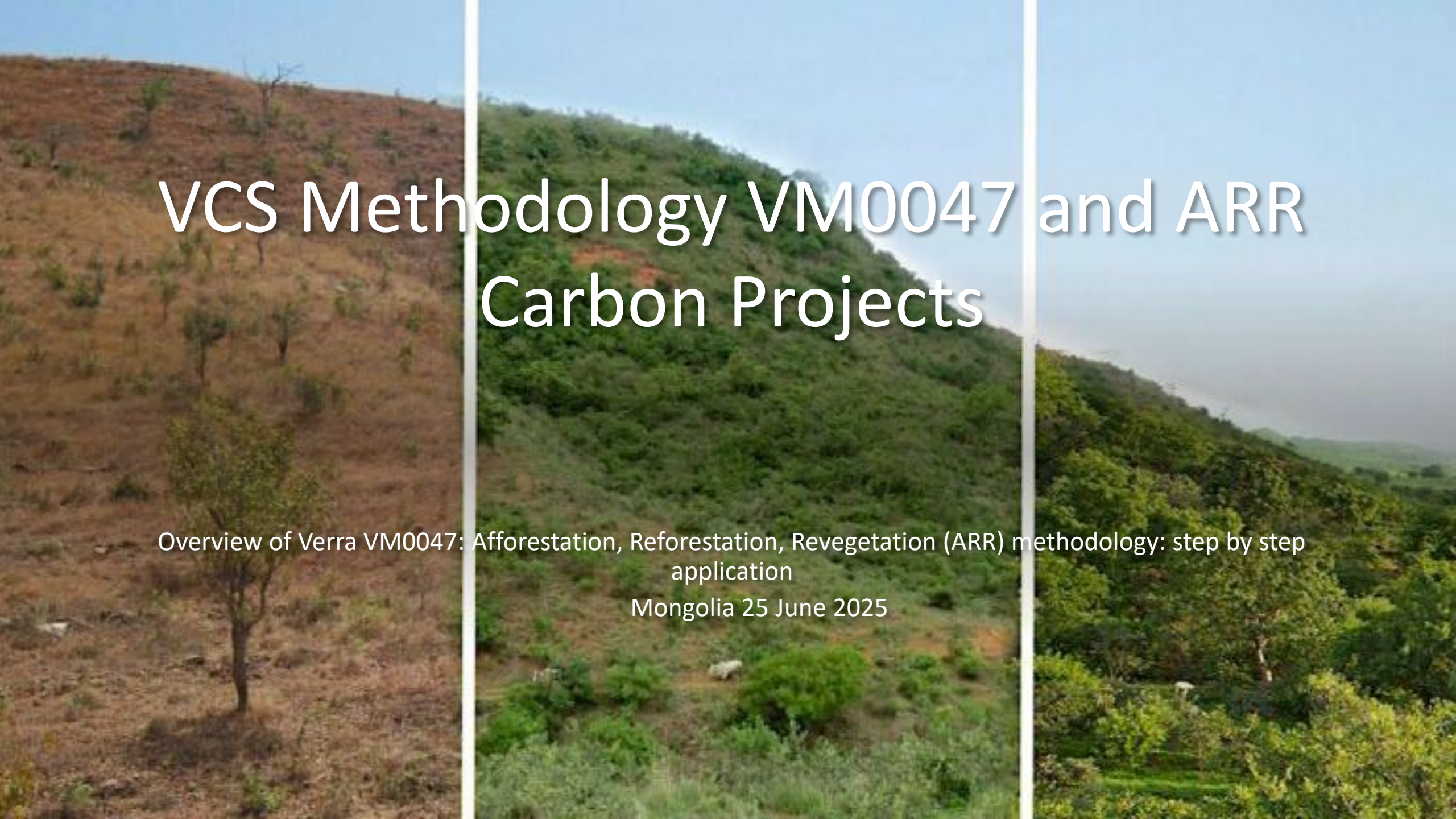


VCS Methodology VM0047 and ARR Carbon Projects

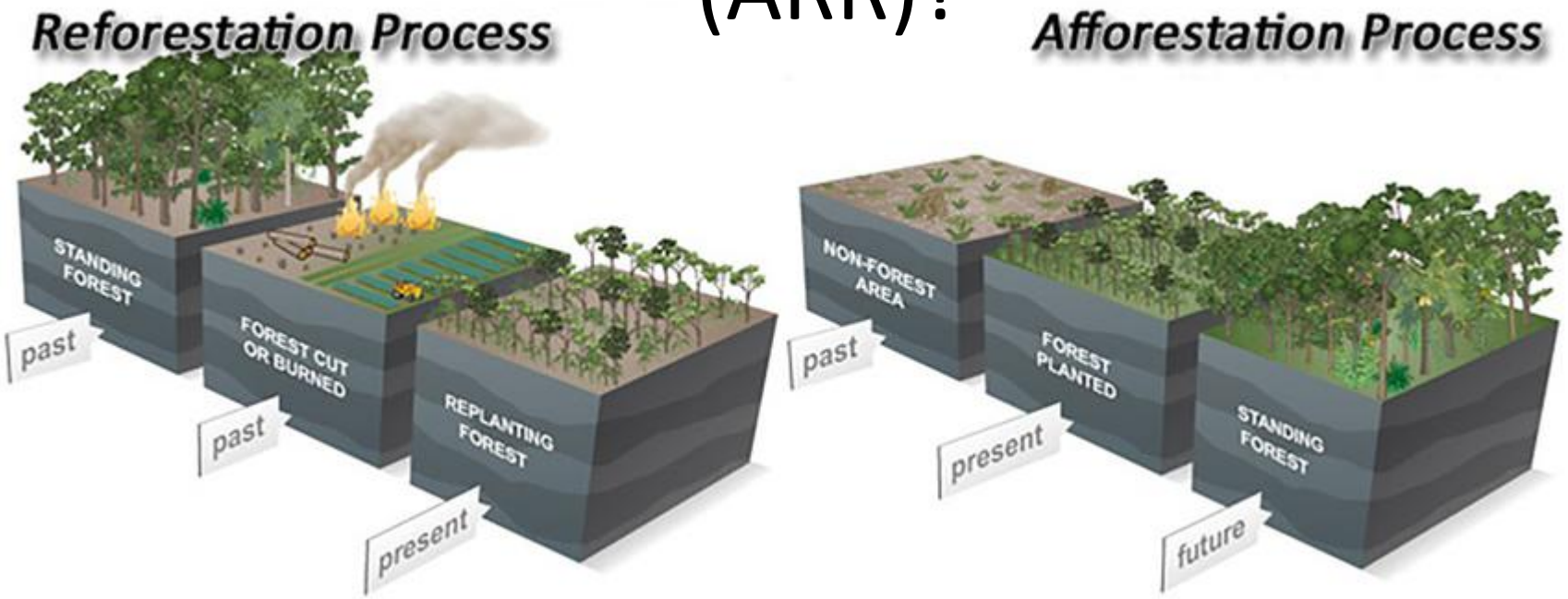
Overview of Verra VM0047: Afforestation, Reforestation, Revegetation (ARR) methodology: step by step application

Mongolia 25 June 2025

Objectives of the Session

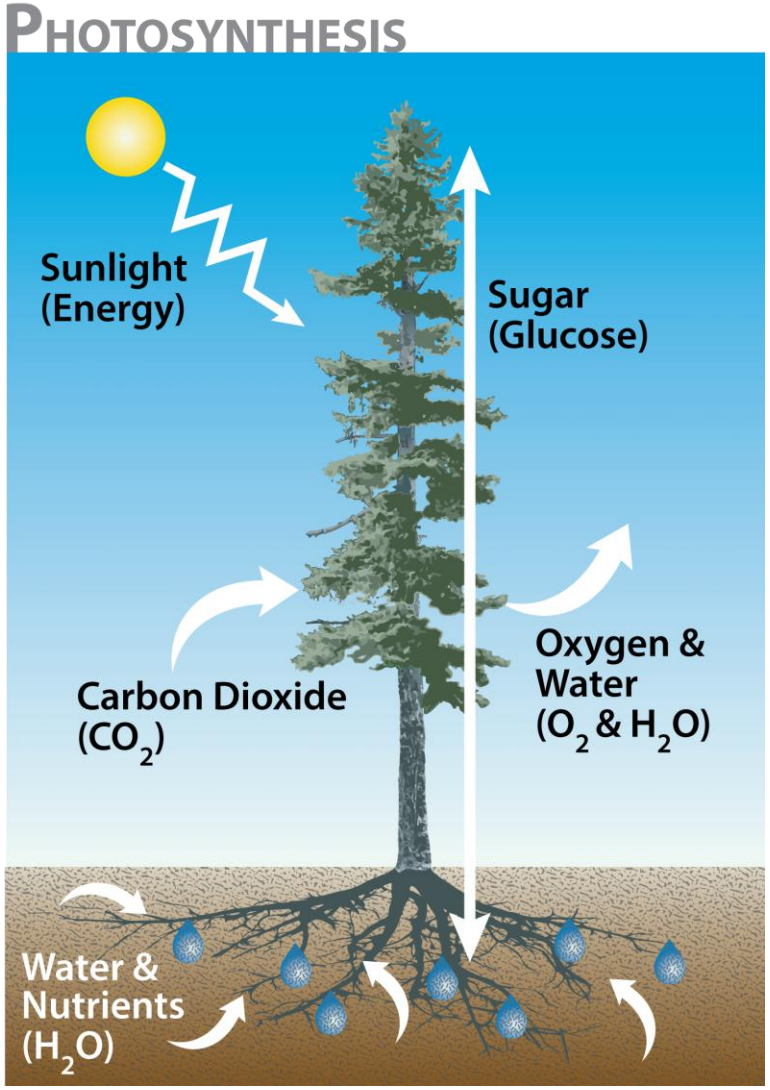
- Understand Afforestation/Reforestation/Revegetation (ARR) carbon projects
- Learn key components of VM0047 methodology and tools
- Visualize an example of the application of VM0047 in Mongolia

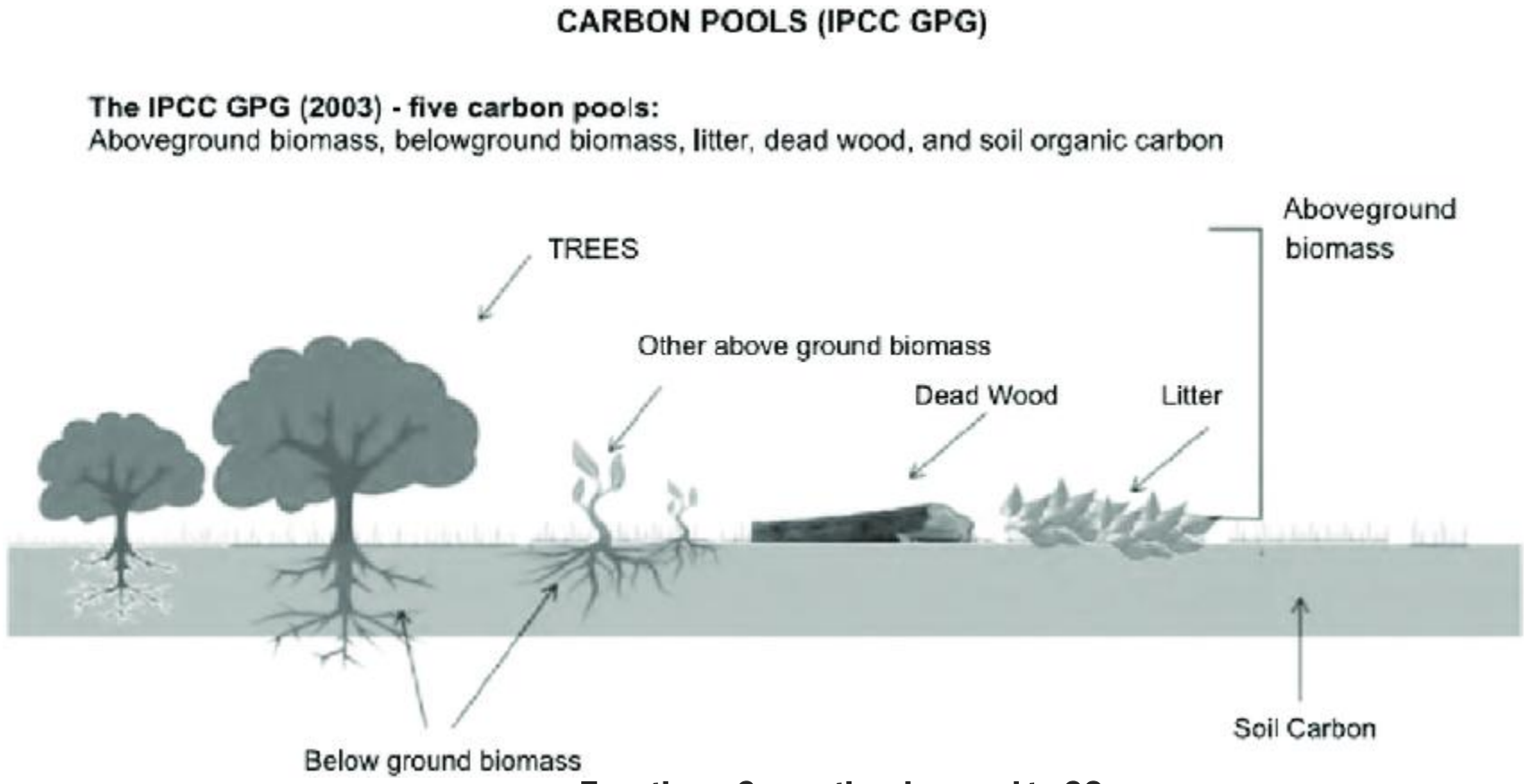
What is Afforestation/Reforestation/Revegetation (ARR)?



Revegetation: activities that increase carbon stocks through establishing or augmenting vegetation on land that doesn't meet the definitions of afforestation or reforestation

How do trees store and sequester carbon?





Density Formula

$$\rho = \frac{m}{V}$$

Equations: Converting dry wood to CO_2

Wood mass x 0.5 = carbon mass

Carbon mass x 3.67 = CO_2 mass

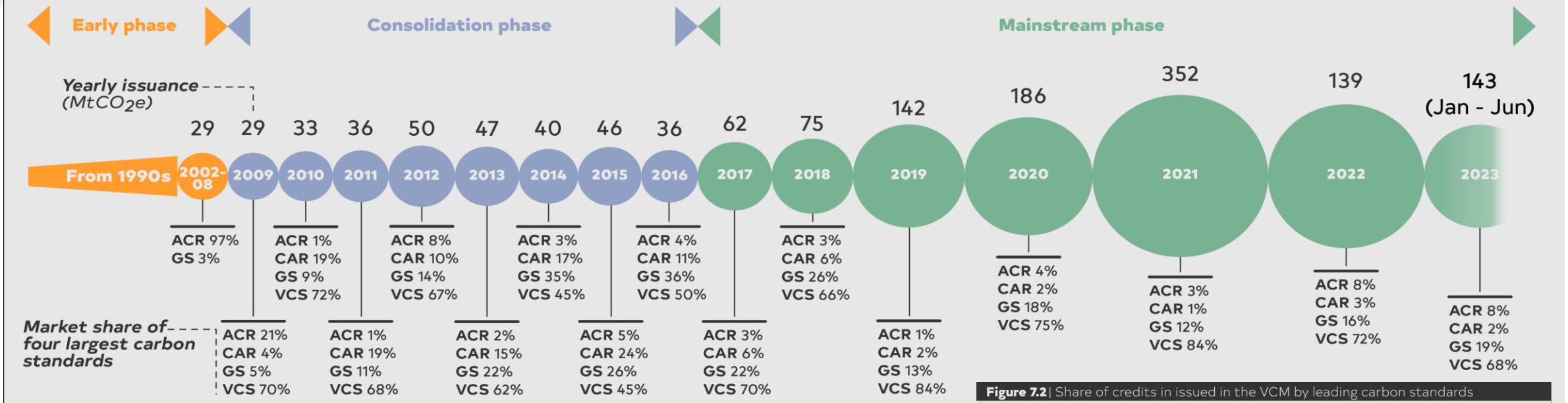
1 metric ton (Mt) of wood x 0.5 x 3.67 = 1.8 Mt CO_2

https://extension.oregonstate.edu/catalog/pub/pnw-775-introduction-forest-carbon-offsets-markets

Overview of Verified Carbon Standard (VCS)

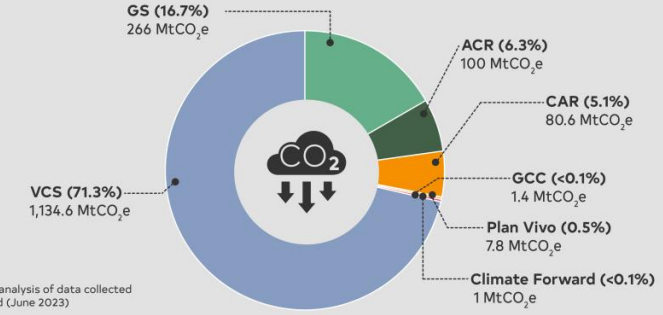
- Verra's VCS is the most widely used voluntary carbon standard
- Ensures integrity through approved methodologies
- Projects must follow a strict development and MRV process

Figure 1.1 | Evolution of the Voluntary Carbon Market (ACR, CAR, GS, VCS)



Source: Climate Focus analysis of data collected for the VCM Dashboard (July 2023).

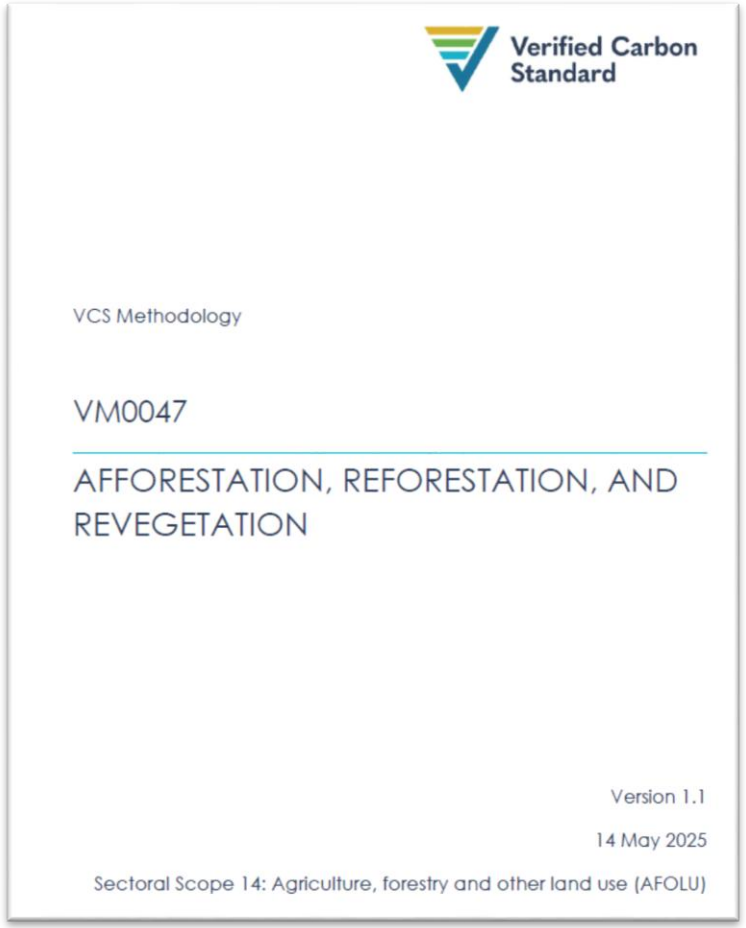
Figure 7.2 | Share of credits in issued in the VCM by leading carbon standards



Verified Carbon Standard
A VERRA STANDARD

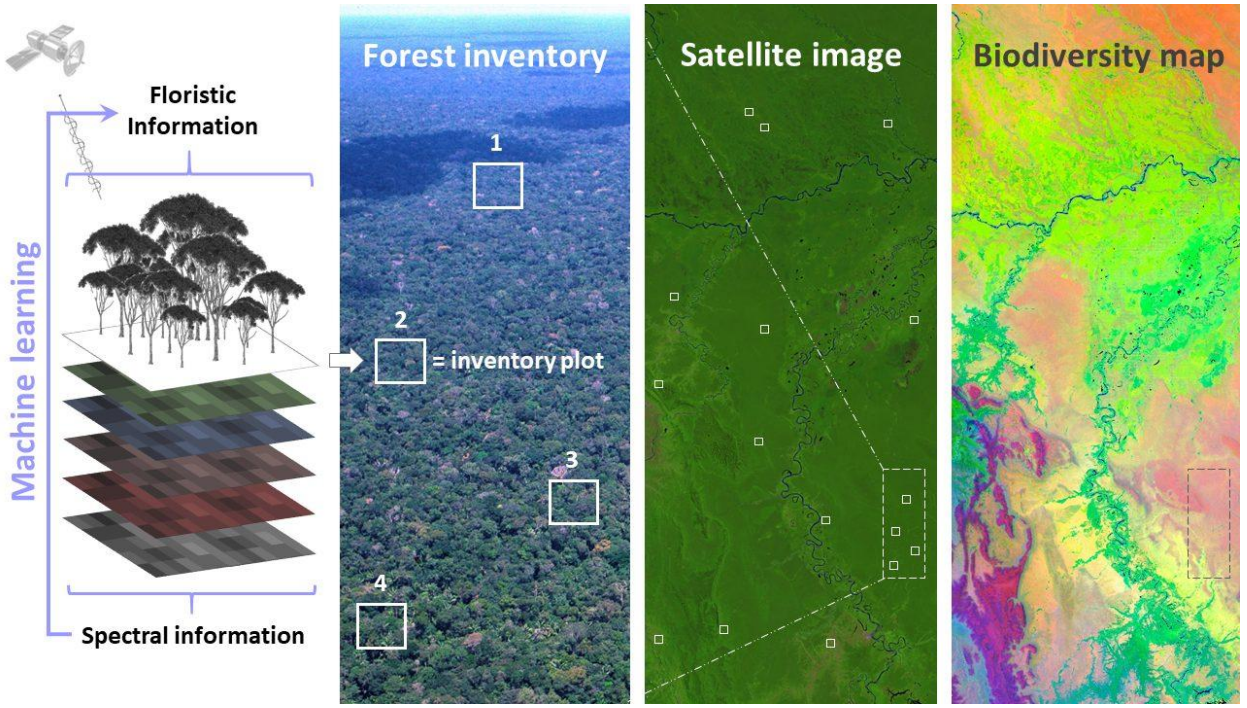
What is VM0047?

- Verra's Verified Carbon Standard (VCS) methodology.
- A consolidated VCS methodology for ARR projects
- Focuses on Afforestation, Reforestation, and Revegetation (ARR) projects.
- Quantifies carbon removals from establishing/restoring vegetative cover or enhancing forest carbon stocks.
- Replaced previous methodologies (AR-ACM0003 and AR-AMS0007)



Why VM0047 matters?

- Enhances robustness and integrity of carbon calculations.
- Incorporates dynamic baselining and remote sensing.
- Aids in standardizing carbon assessments for ARR projects.
- Enables projects to qualify for Core Carbon Principles (CCP) labels.



Two Approaches: Area-Based vs. Census-Based

- **Area-based approach:** For projects creating continuous areas of trees/shrubs over more than one hectare (large-scale).

- **Census-based approach:** For small project areas with direct planting of individual trees, where trees can be comprehensively counted (e.g., urban forestry, agroforestry). Max 50 planting units per hectare

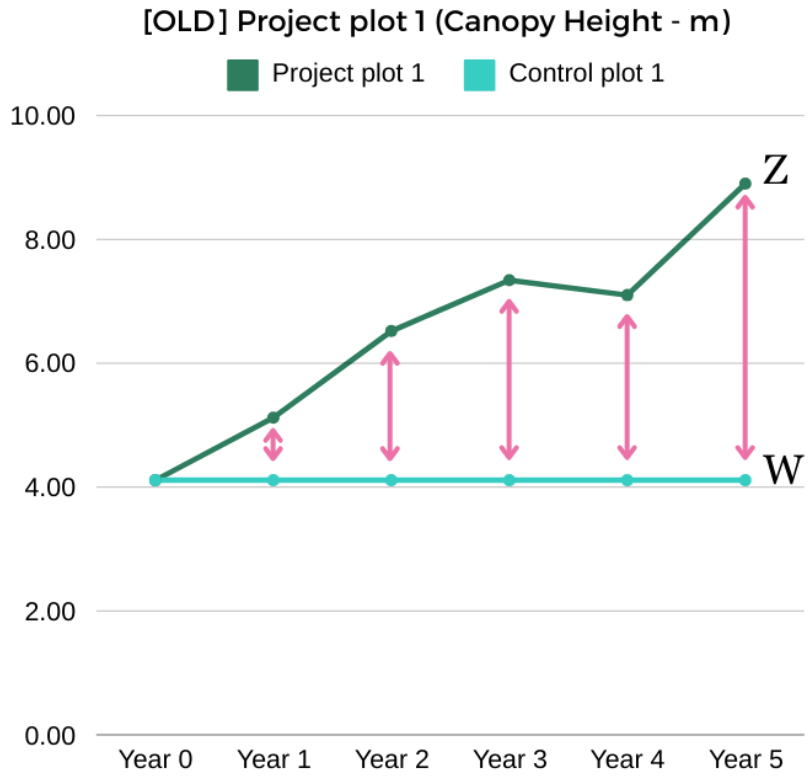
Both can be used in the same project, but areas must be distinct.

Applicability Conditions

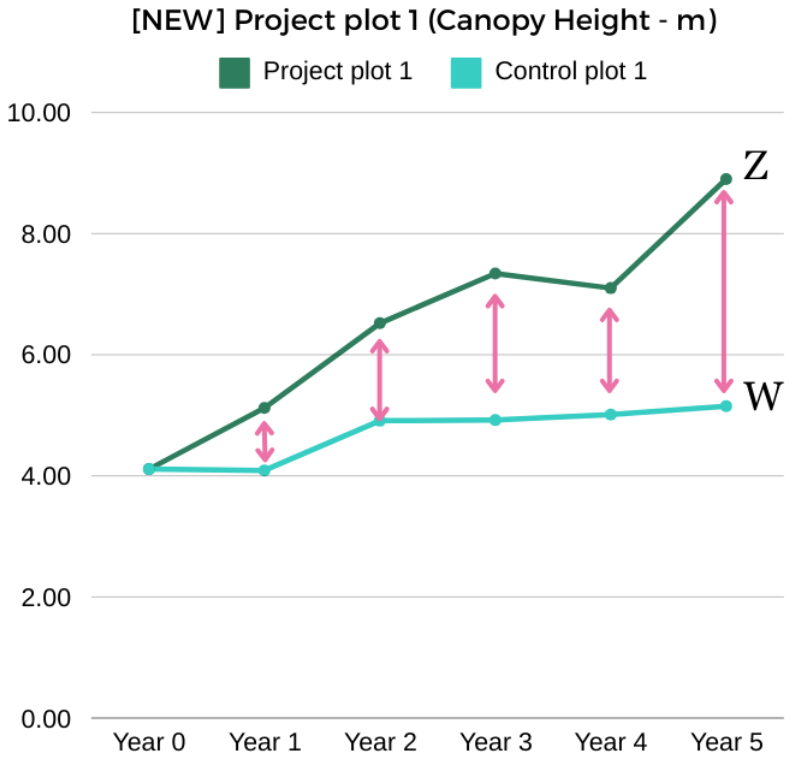
- 1) Project activities increase vegetative cover.
- 2) Where area-based and census-based approaches are used together, they are applied in non-overlapping areas
- 3) For lands enrolled in a project, the quantification approach is selected at the project start date and used for the entire project crediting period.
- 4) The project start date is documented as the earliest of the following:
  a) The date on which site preparation activities began;
  b) The land use change date
- 5) Where projects take place on organic soils or wetlands, a Wetland Restoration and Conservation methodology must be used to account for other carbon pools.

Key Innovations & Requirements

– **Dynamic Baselining:** Compares project area to similar reference areas over time using remote sensing.



Static baseline (old methodology)

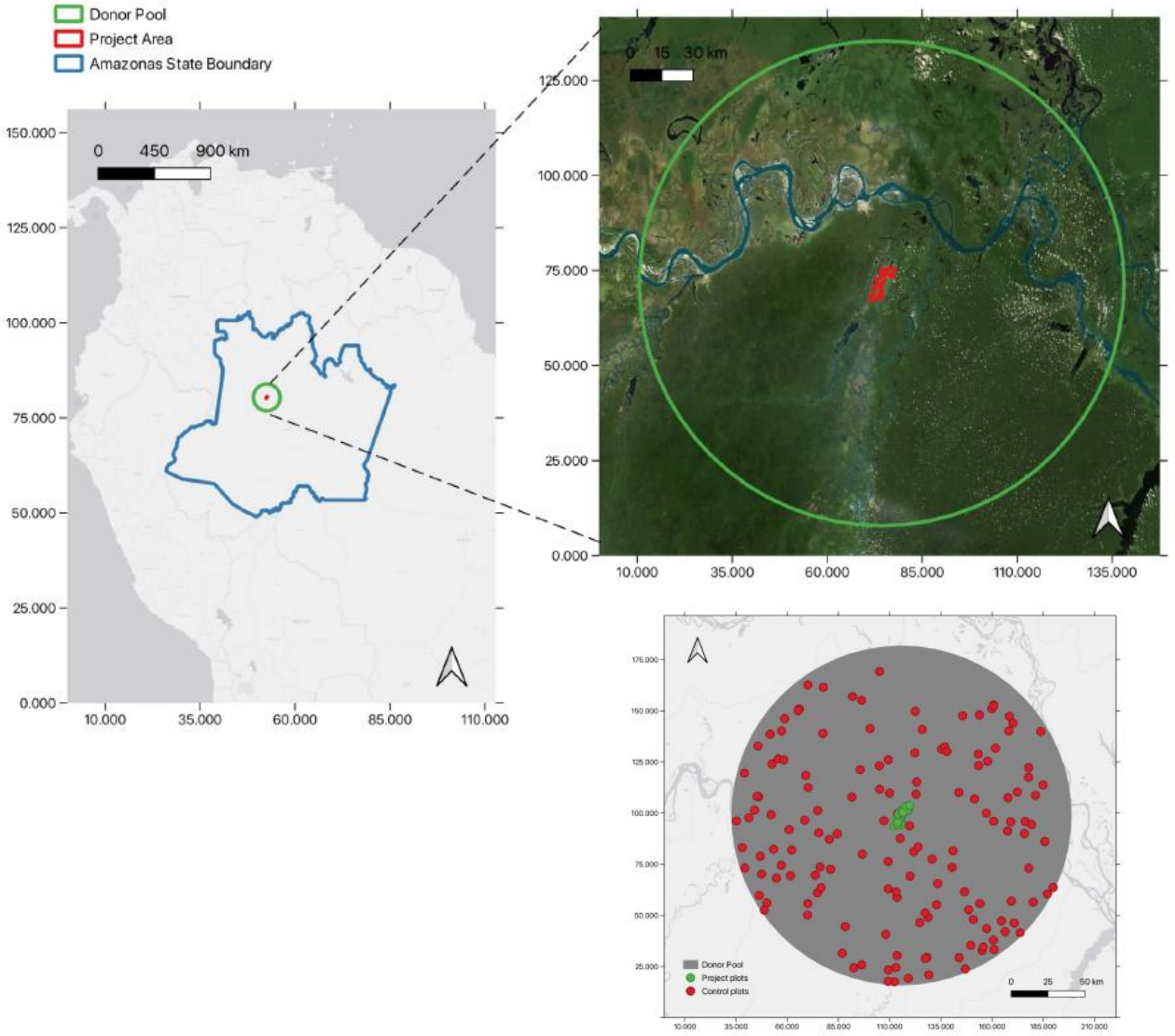


Dynamic baseline (new methodology)

Key Innovations & Requirements (cont.)

Control Plots: Selection of similar locations within a 100 km radius for comparison.

Geospatial Data: Essential for defining donor pool areas and selecting control plots.

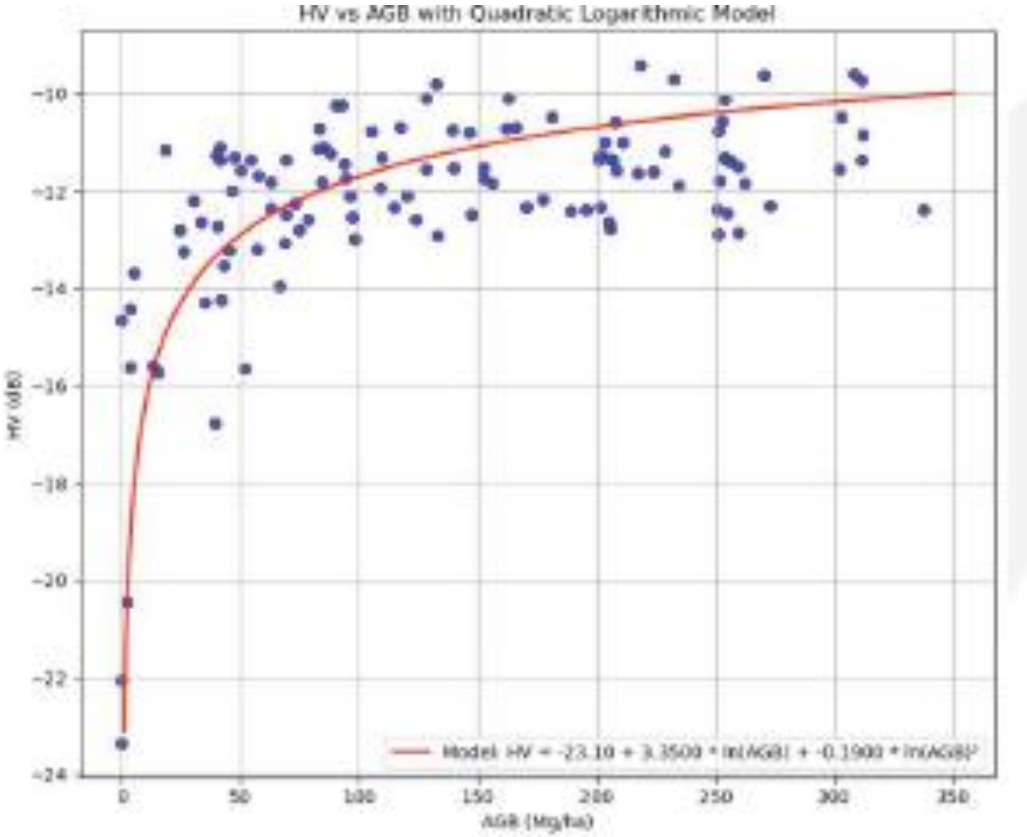


Key Innovations & Requirements (cont.)

Remote Sensing: Allows for estimation of pre-existing woody biomass and ongoing monitoring of vegetation changes.

Stocking index (SI)

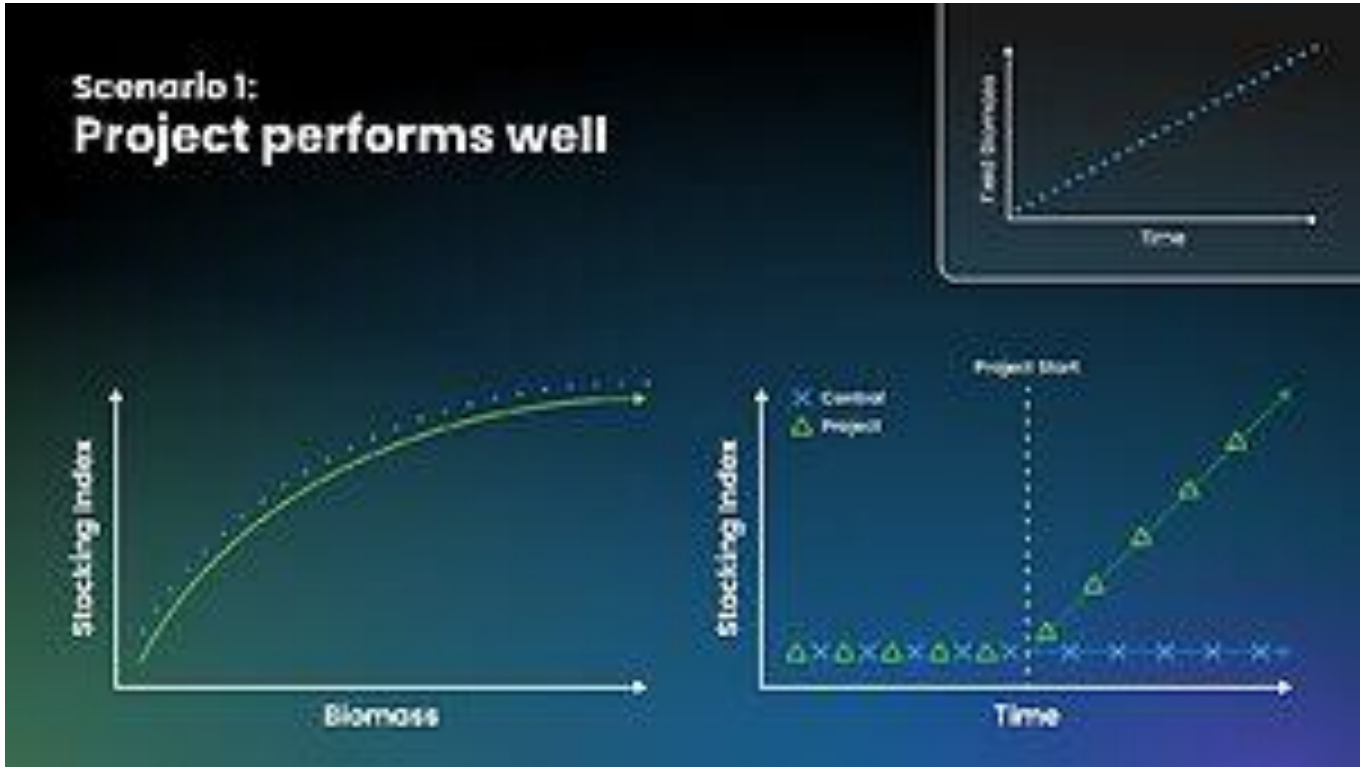
An unspecified remote sensing metric with demonstrated correlation with terrestrial aboveground carbon stocks (e.g., normalized difference fraction index – NDVI – from Landsat imagery, average canopy height derived from light detection and ranging (LiDAR)).



← ***Figure 2.*** *The relationship between HV backscatter (dB) and AGB (Mg/ha). The red line shows the fitted second degree (quadratic) logarithmic model.*

https://www.space-intelligence.com/

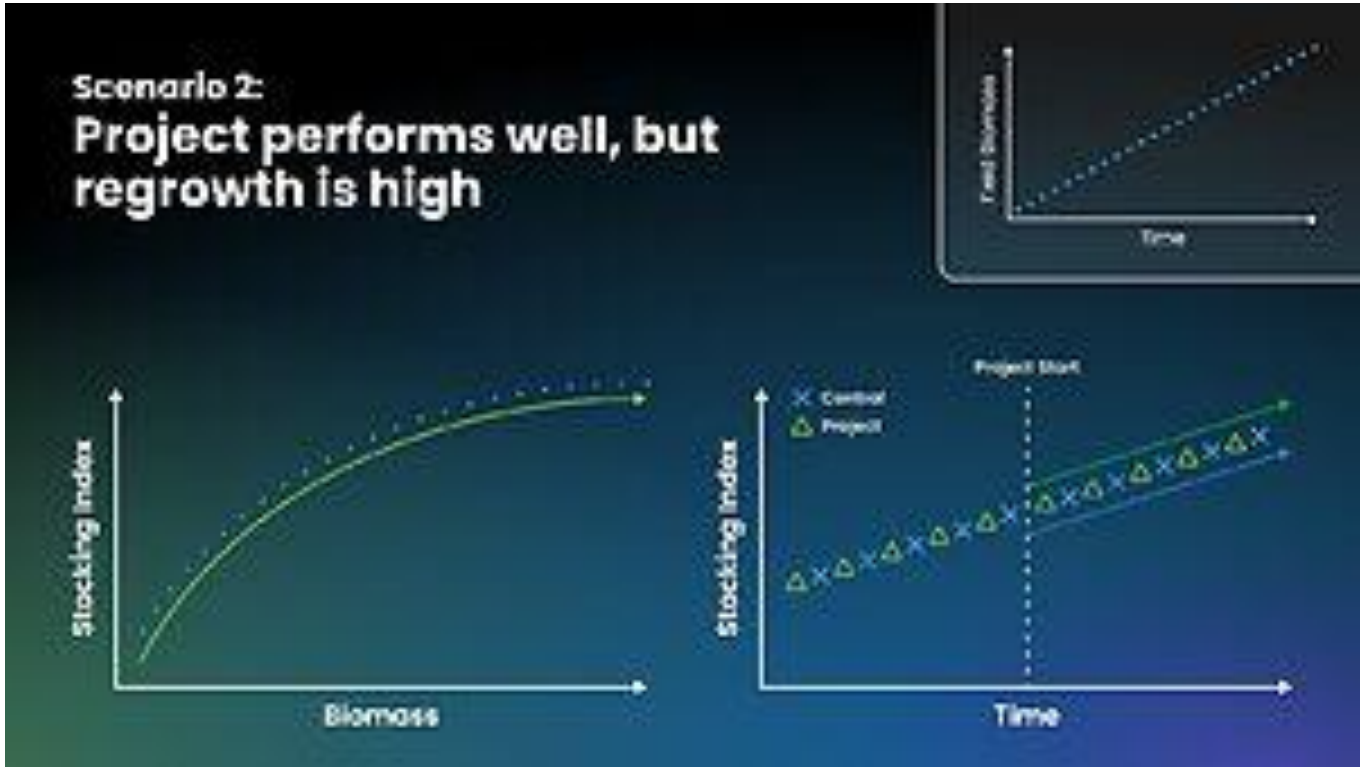
The Role of the Stocking Index in VM0047 Dynamic Baseline



- The stocking index is well chosen and closely tracks biomass.
- Tree biomass in the project area is increasing.
- The project will receive accurate credits based on actual removals

https://www.space-intelligence.com/2025/04/01/stocking-index-for-vm0047-credit-issuance/

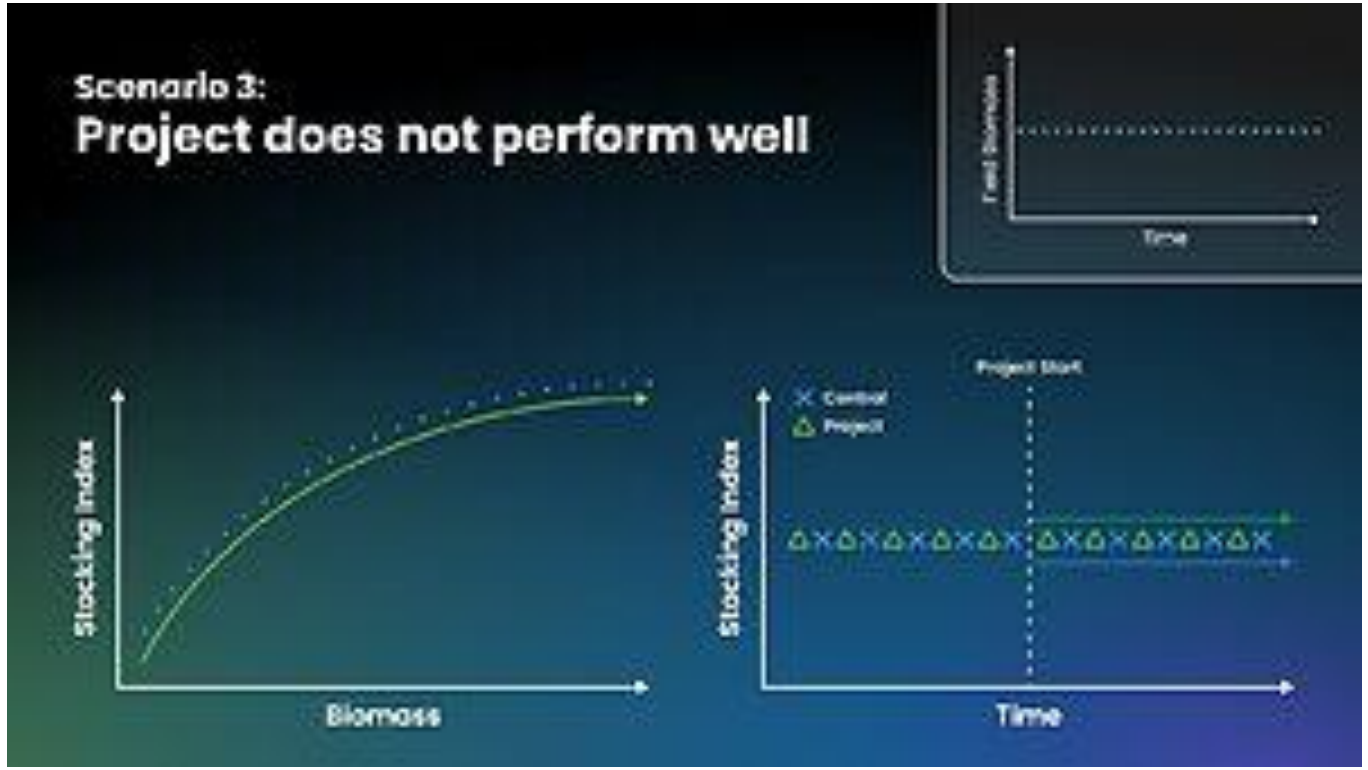
The Role of the Stocking Index in VM0047 Dynamic Baseline



- The stocking index is well chosen and closely tracks biomass.
- Tree biomass in the project area is increasing.
- However, there is high regrowth outside the project area.
- As a result, the project will be credited accurately for removals achieved.
- Due to severe baseline discounting, the project will not be able to credit many credits

https://www.space-intelligence.com/2025/04/01/stocking-index-for-vm0047-credit-issuance/

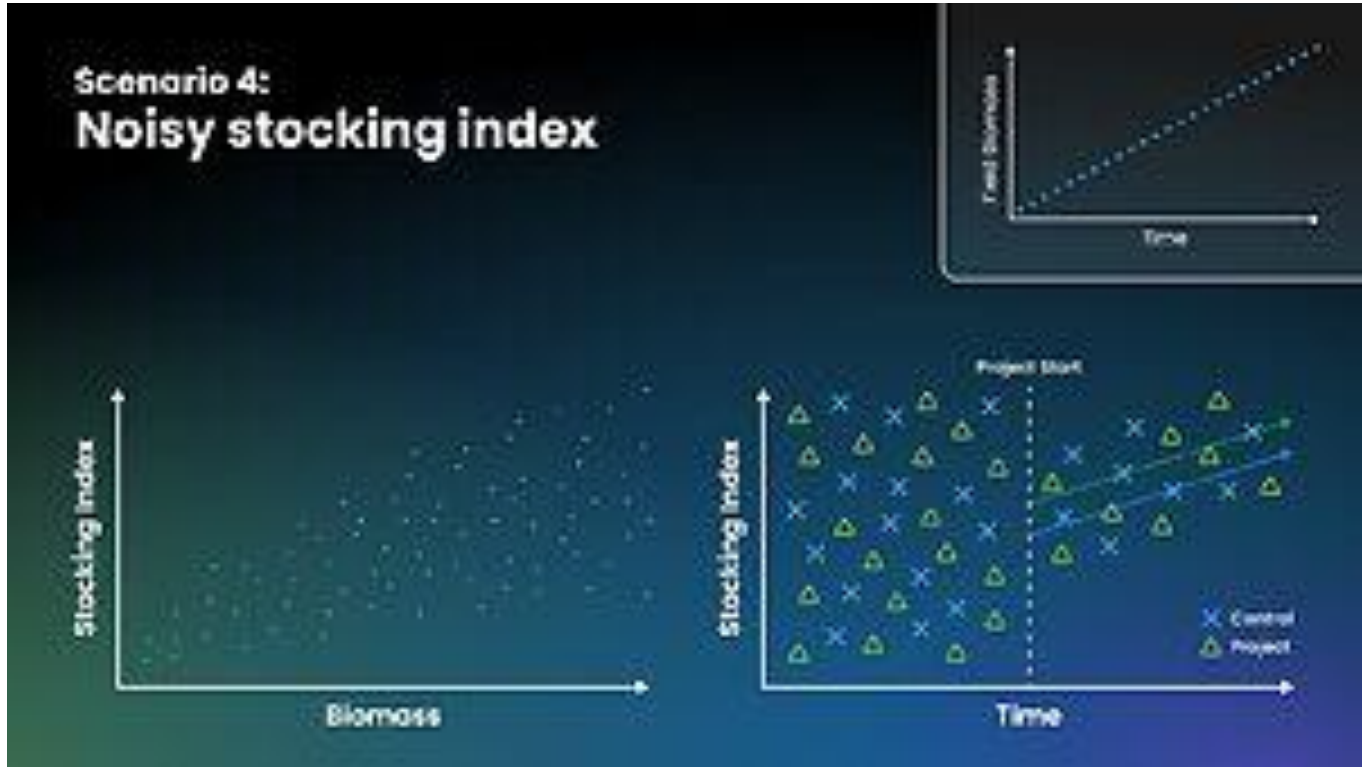
The Role of the Stocking Index in VM0047 Dynamic Baseline



- The stocking index is well chosen and closely tracks biomass.
- Tree biomass in the project area has not increased since project start.
- Due to low project impact, the project will not be able to claim many credits.
- However, it will be credited correctly respective to removals achieved

https://www.space-intelligence.com/2025/04/01/stocking-index-for-vm0047-credit-issuance/

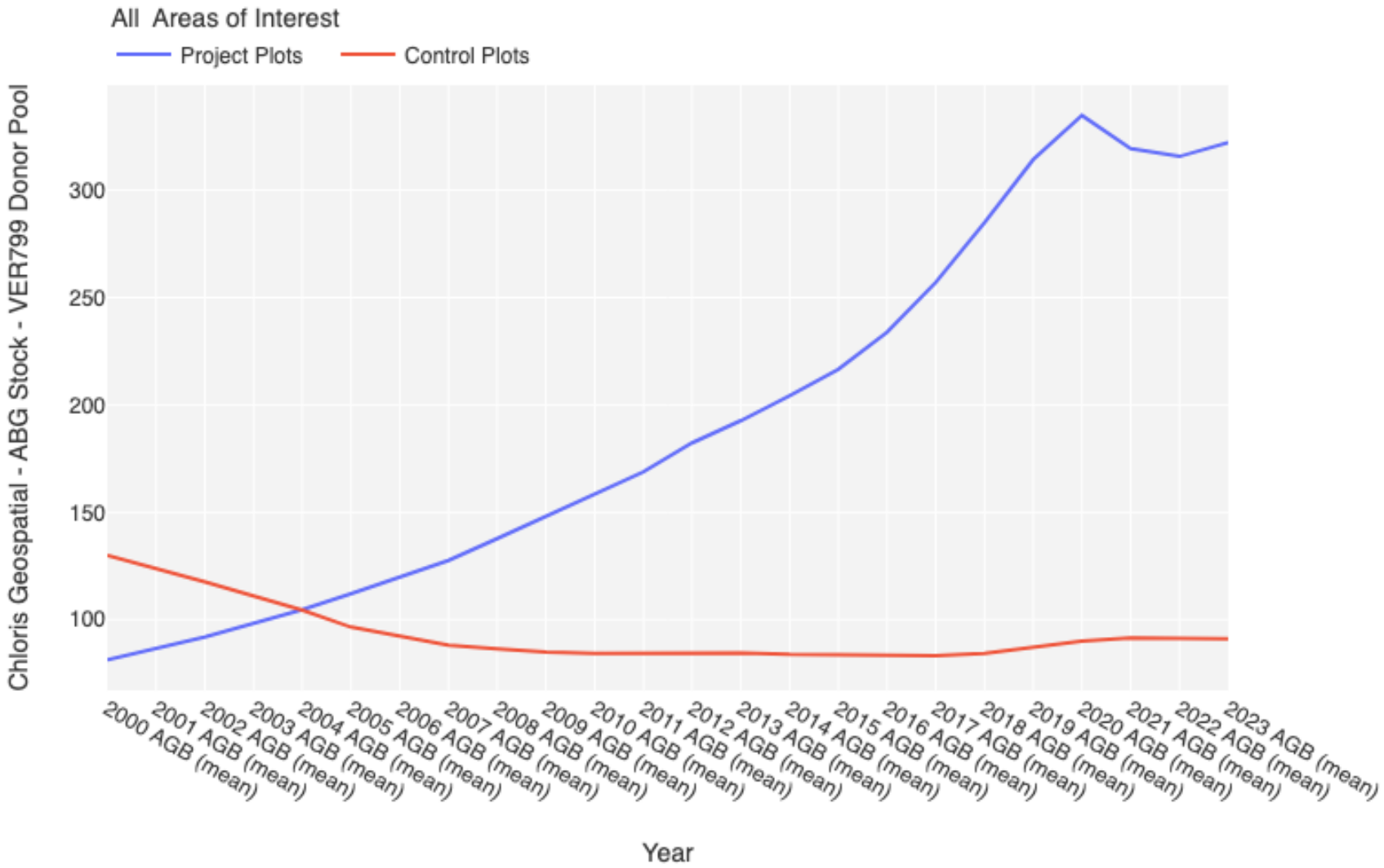
The Role of the Stocking Index in VM0047 Dynamic Baseline



- The stocking index is not well chosen, leading to a weak correlation with biomass.
- Despite good project performance, high noise in the data noise obscures the impact of removals.
- As a result, the project will be under-credited for actual removals achieved.

https://www.space-intelligence.com/2025/04/01/stocking-index-for-vm0047-credit-issuance/

Project Performance



VM0047 v1.1 Updates (Recent Revisions)

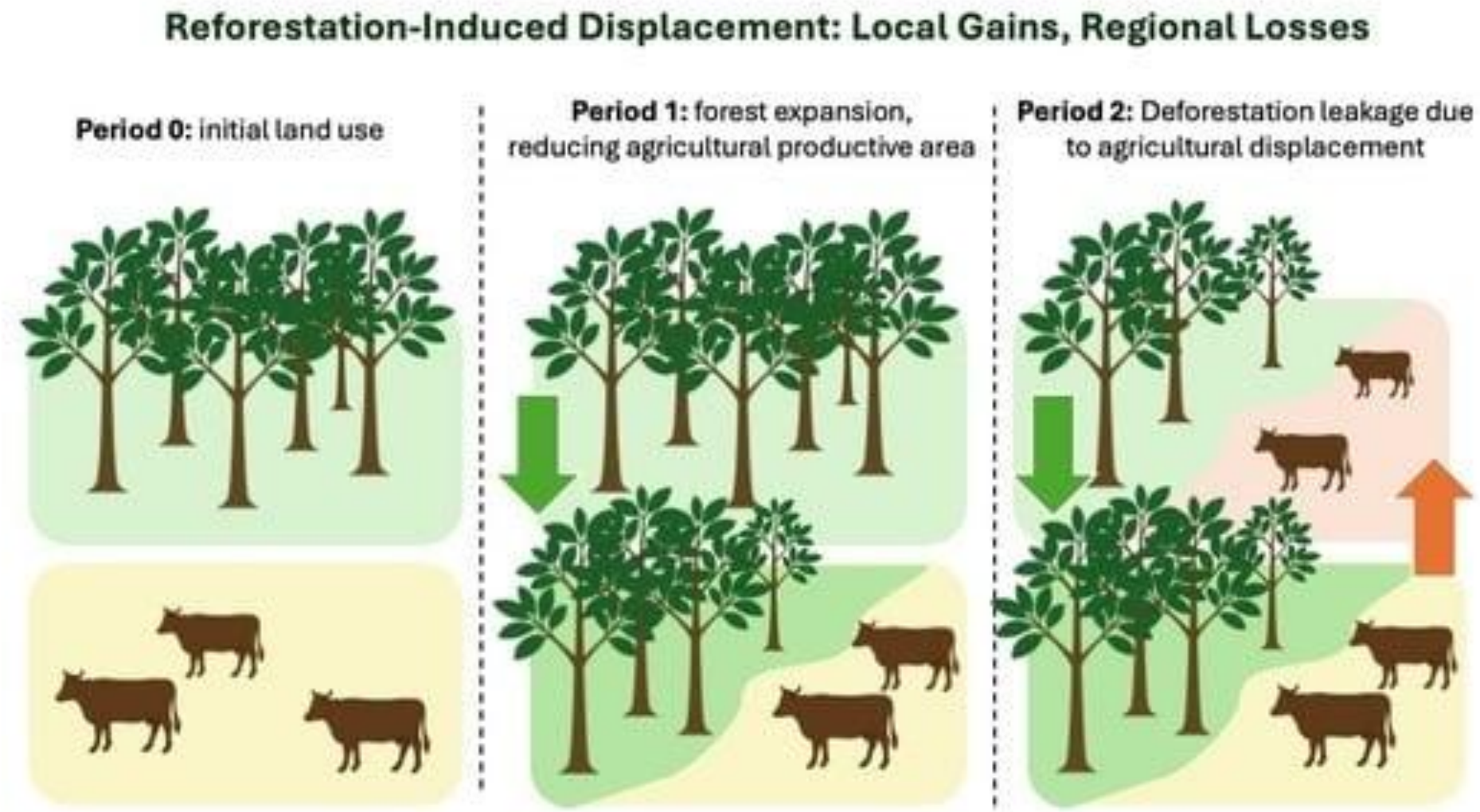
- Allows project activities on lands with existing forests (degraded forests).
- Expanded use of remote sensing for pre-existing biomass estimation.
- Clarifies distinction between area-based and census-based approaches.
- Updated requirements for GPS and physical markers for census-based approach.

VMD0054
MODULE FOR ESTIMATING LEAKAGE FROM ARR ACTIVITIES

Understanding VMD0054

- **VCS Module:** A specific component within the Verified Carbon Standard (VCS) Program.
- **Mandatory for VM0047:** Must be used in conjunction with the VM0047 methodology.
- **Focus on Leakage:** Its primary purpose is to estimate and account for potential leakage from ARR projects.
- **Ensuring Accuracy:** Aims to provide a more accurate assessment of the net carbon benefits of ARR activities.

Leakage


Reforestation-Induced Displacement: Local Gains, Regional Losses
Period 0: initial land use
Period 1: forest expansion, reducing agricultural productive area
Period 2: Deforestation leakage due to agricultural displacement

How does VMD0054 work?

Step 1: Determine Foregone Production in Project Area

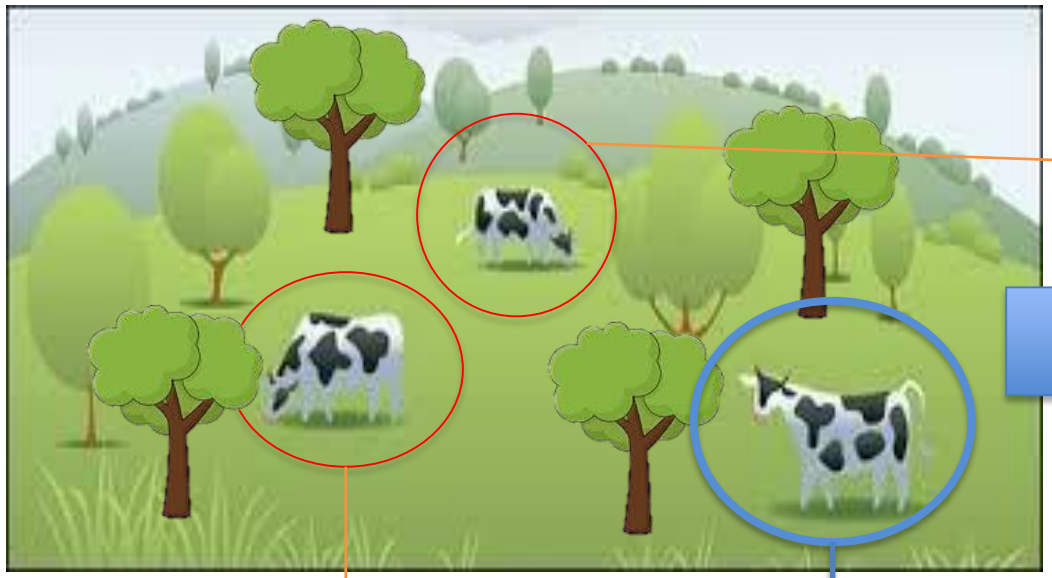
- The baseline agricultural and fuelwood commodity production in the project area must be demonstrated using historical production records for each commodity during the chosen reference period.

$$FP_{j,t} = BP_{j,t} - MP_{j,t}$$

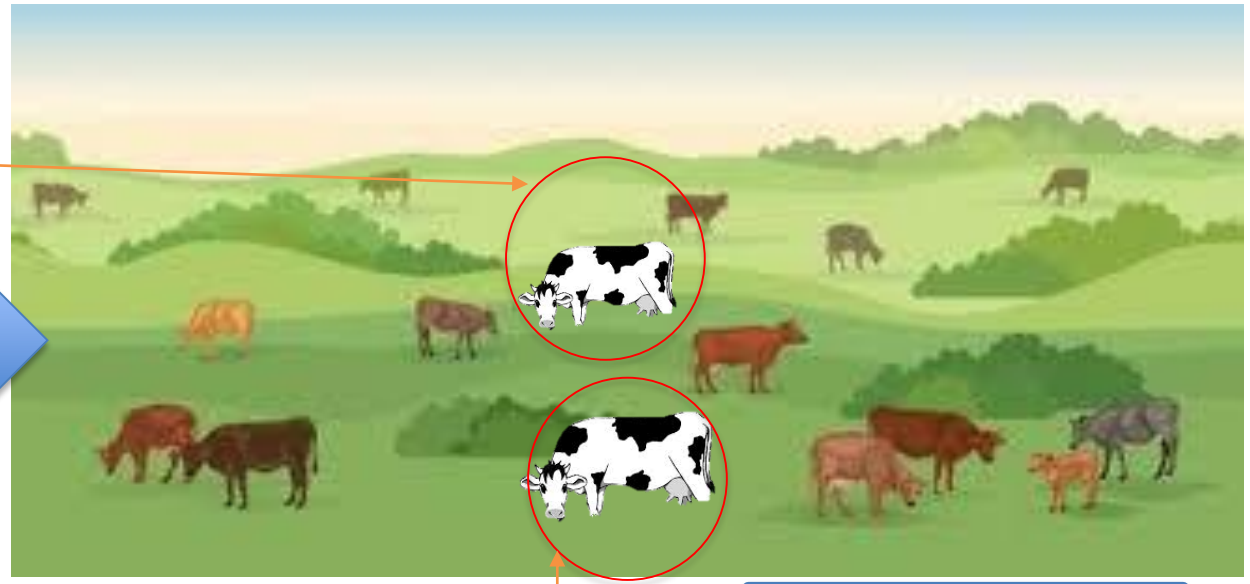
How does VMD0054 work?

- Step 2: Determine the Impact of Leakage Mitigation Activities

Project area



leakage mitigation areas



$$l_{j,t} = MAX\ (FP_{j,t} - LM_{j,t}, 0)$$

New Land Brought into Production

How does VMD0054 work?

- Step 3: Determine Amount of New Land Brought into Production

$$AL_t = \sum_{j=1}^{T} INL_{j,t} \quad (7)$$

Where:

AL_t	=	Area generating leakage emissions in year *t* (ha)
$INL_{j,t}$	=	Area of new land brought into production for commodity *j* in year *t* (ha)
T	=	Total number of commodities produced in historical reference period
t	=	1, 2, 3, …, *t* years elapsed since the project start date

How does VMD0054 work?

- Step 4: Determine Change in Carbon Stocks in New Lands Brought into Production

change in forest biomass carbon stocks

$$CS = \Delta C_{biomass} + \Delta SOC$$

Change in soil organic carbon (SOC)

How does VMD0054 work?

- Step 5: Determine Leakage Emissions

$$LK_t = AL_t \times CS \times 44/12 \qquad (10)$$

Where:

LK_t	=	Cumulative leakage up to year *t* (t CO_2e)
AL_t	=	Area generating leakage emissions in year *t* (ha)
CS	=	Change in carbon stocks on new lands brought into production (t C/ha)
t	=	1, 2, 3, …, *t* years elapsed since the project start date, *t* must not exceed five years beyond the last project instance start date
44/12	=	Conversion factor from C to CO_2e

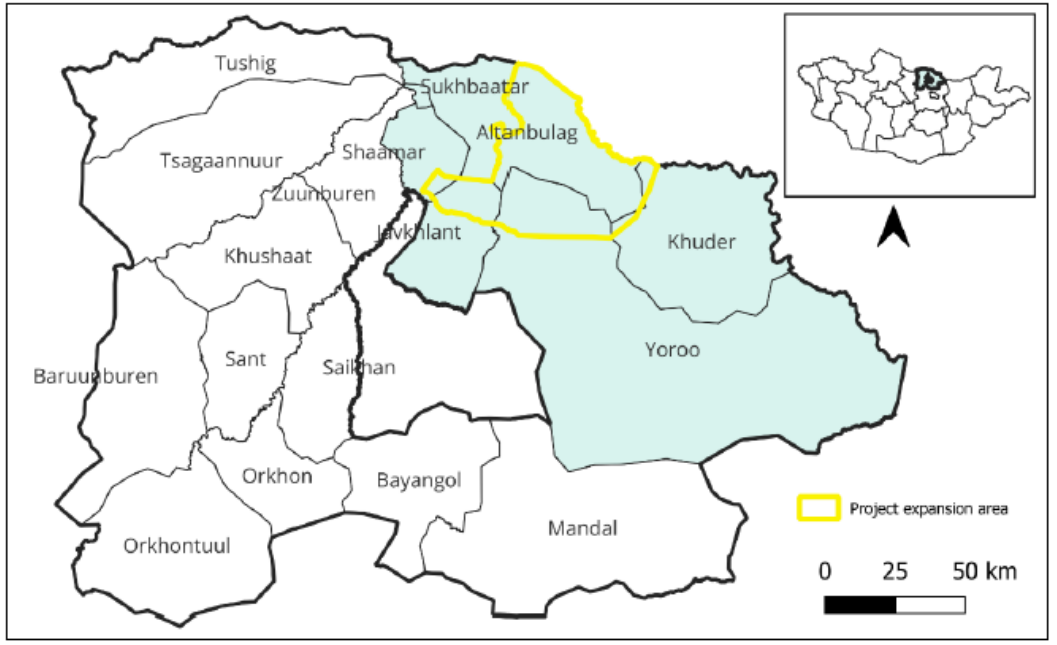
EXAMPLE OF ARR PROJECT IN MONGOLIA USING VM0047 METHODOLOGY

Verified Carbon Standard

BOREAL CARBON – PROJECT GAMMA I

Project title	Boreal Carbon – Project Gamma I
Project ID	5446
Crediting period	01-May-2025 to 30-April-2065
Original date of issue	15-02-2025
Most recent date of issue	15-02-2025
Version	1.0
***VCS Standard* Version**	VCS Standard v4.7
Prepared by	Boreal Carbon Forestry III 20 Cecil Street, #05-03 Plus Singapore, 049705 Jessica Vardy jessicavardy@borealcompany.com

Figure 7 Project location in Selenge (large picture) and Mongolia (small picture)



Northeastern part of the Selenge Province (aimag), in the soums of Yoroo, Javkhlant, Altanbulag, Shaamar and Khuder.

Project Gamma Summary

- Aims to restore approximately **30 000 ha of deforested land in Selenge province**, northern Mongolia, over the next **5-10 years**.

- **Forests are planted purely for carbon sequestration and biodiversity purposes** – no harvesting is included within the plans.

- The planting plan includes pine (Pinus sylvestris), larch (Larix sibirica), poplar (Populus laurifolia) and elm (Ulmus pumila).

- The project will be implemented by Boreal Company Holdings Pte Ltd, registered in Singapore and its wholly owned Mongolian subsidiary Nomgon Forestry LLC as a grouped project

- Expect to generate **3 904 000 tonnes CO2 equivalent over 40 years** , with estimated average annual removals of 97 600 tonnes CO2

Discussion: Cost analysis

- Why is the estimate for this project differs so much from the EX-ACT example (3.9 mio vs 9 mio)?

- What is the cost for establishing 1 ha of forestry plantation? What could be the overall cost of the project be?

- At what price should the project sale each carbon unit to become profitable?

Project Gamma will plant seeds, seedlings and saplings, using both mechanized and manual planting and promote natural regeneration.

Seeds, seedlings and saplings will be secured through local seedbanks and nurseries, as **required by Mongolian law.**

Nomgon Forestry is setting up its own nursery to supply seedlings to Project Gamma and its sister projects, which are currently in planning.

Construction of a pilot nursery commenced in November 2024, with seedling production expected to begin in spring 2025.

Figure 1 Construction of the pilot nursery

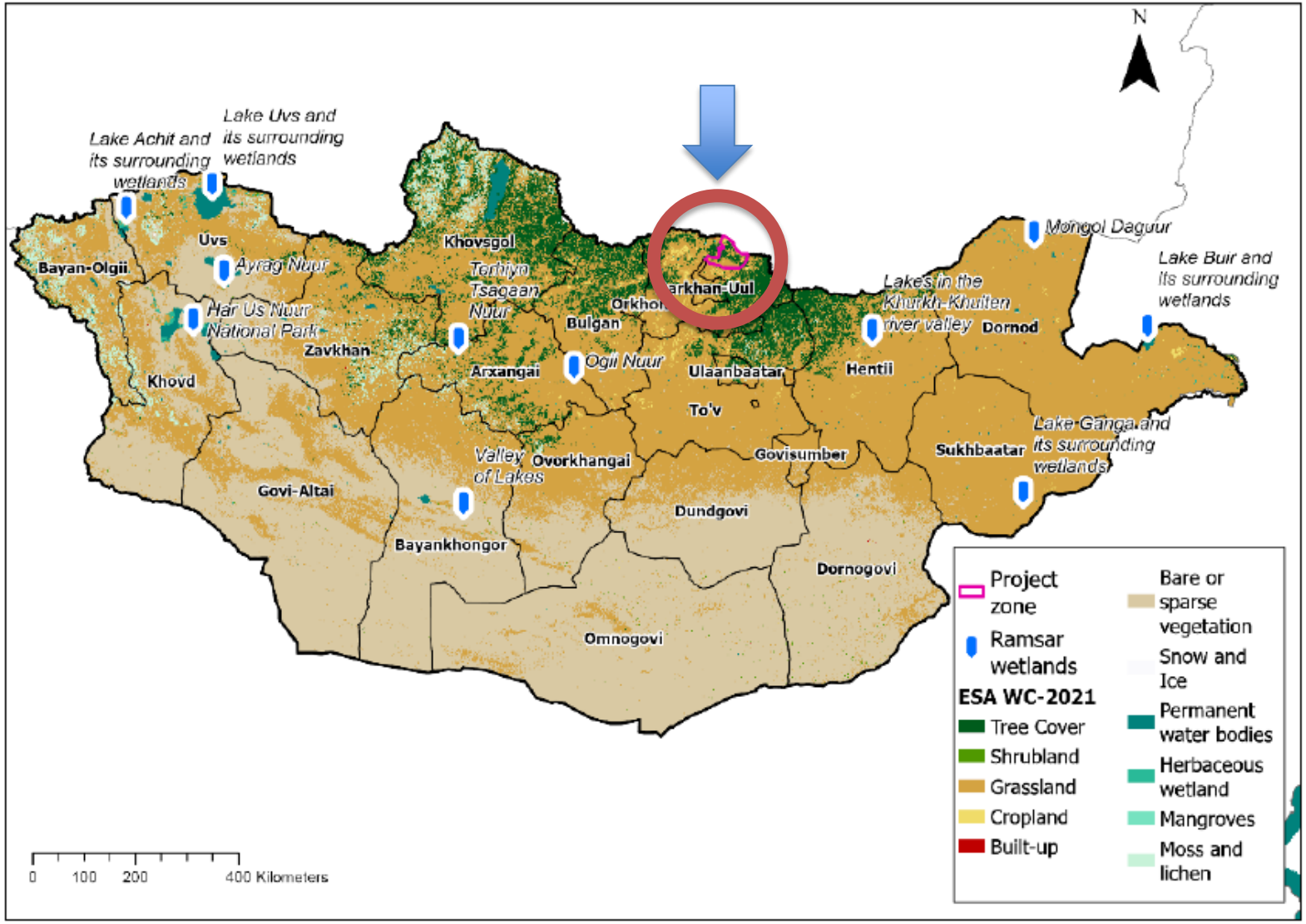
The areas for reforestation have typically been used for **recurring grazing of livestock**

The project has acquired roughly 690 ha of forest loss area (subject to changes as inventories are carried out), 54 ha of which is ready to be planted with pine in May 2025

1.3 Sectoral Scope and Project Type

Sectoral scope	Agriculture, Forestry and Other Land Use (AFOLU)
AFOLU project category[1]	Afforestation, Reforestation and Revegetation (ARR), and Agriculture Land Management (ALM)
Project activity type	Activities that increase carbon stocks in woody biomass (and in some cases soils) by establishing, increasing, and/or restoring vegetative cover through planting, sowing, and/or the human-assisted natural regeneration of woody vegetation.

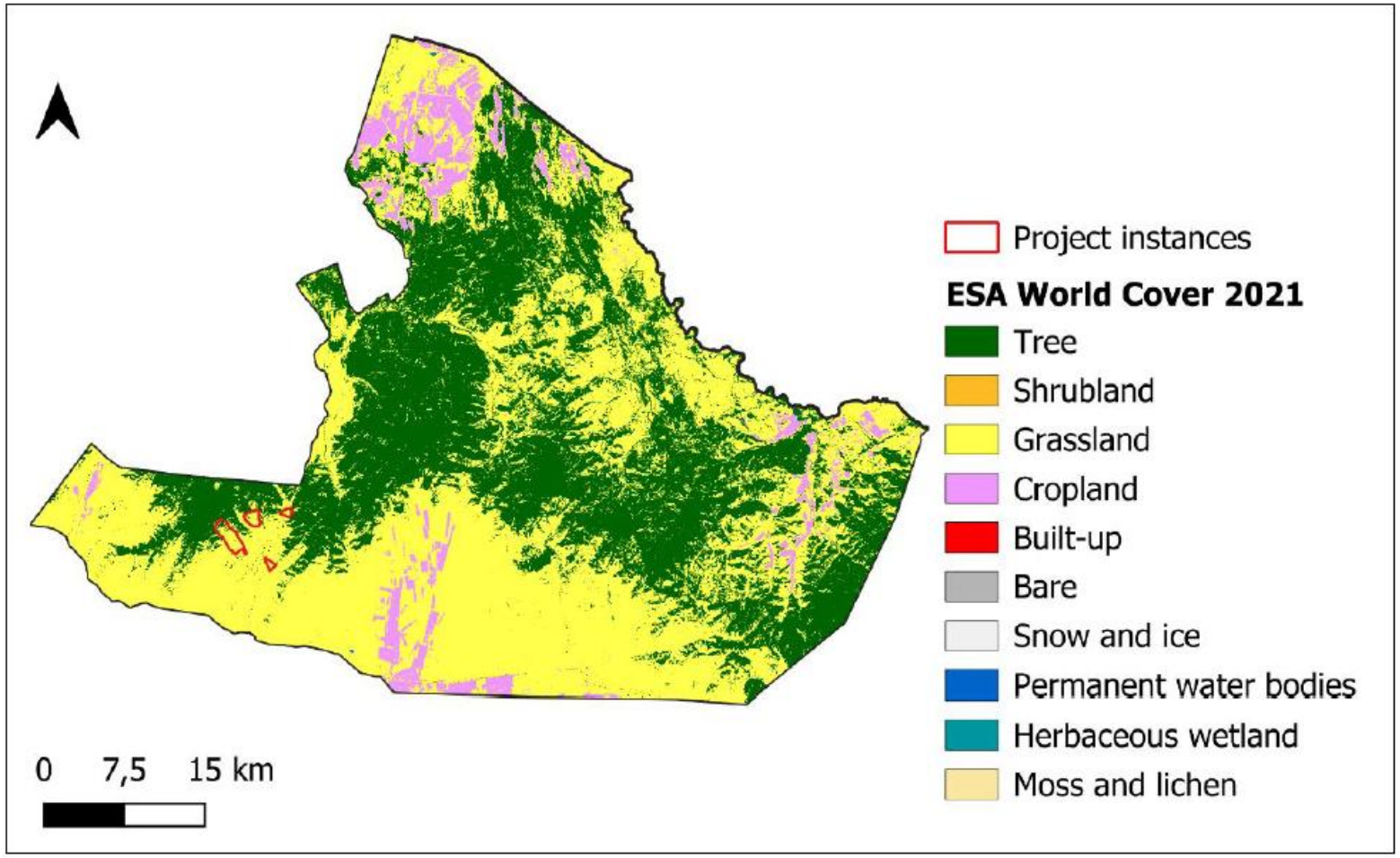
Figure 2 Mongolia and project expansion area



Source: ESA World Cover 2021, Ramsar Global Wetland

Project activities are restricted from occurring on organic soils or wetlands and deliberation alteration of the water table will not be pursued. The presence of such areas was assessed using ESA World Cover 2021 data

Figure 3 Land use and vegetation cover of the project expansion area and activity instances

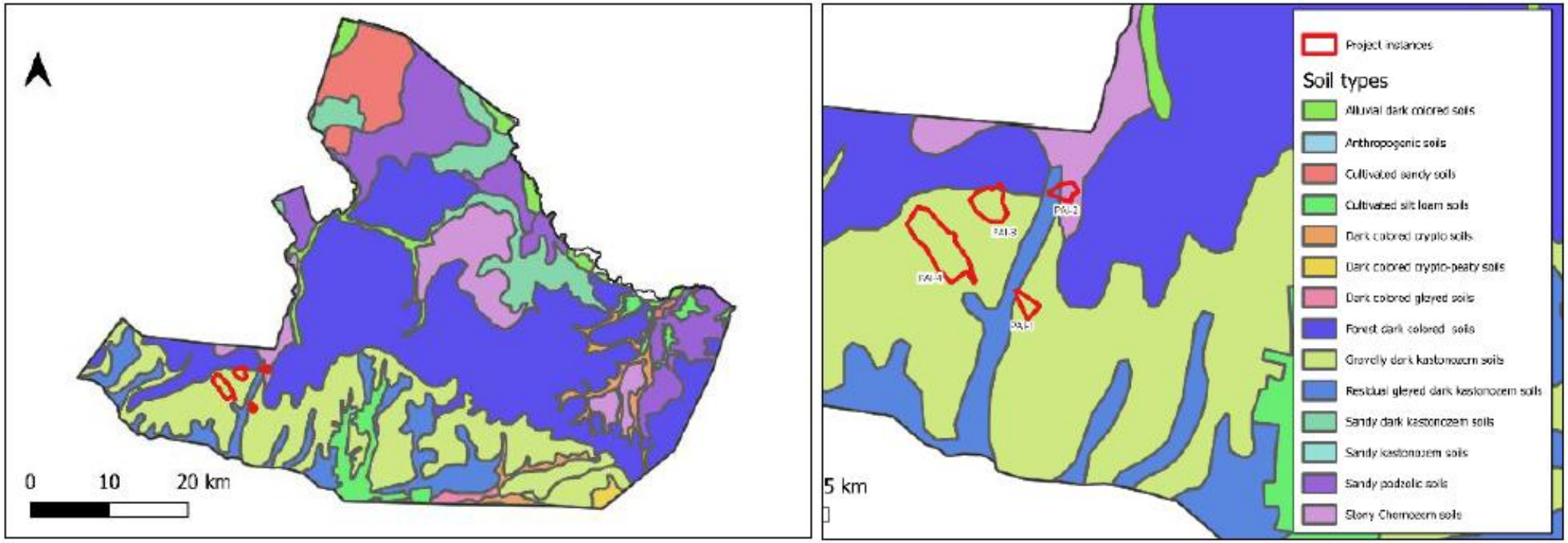


Source: ESA World Cover 2021

The major land cover types in the project expansion areas are forests, grasslands, and croplands. Forests are mostly in the central and northern high-altitude areas

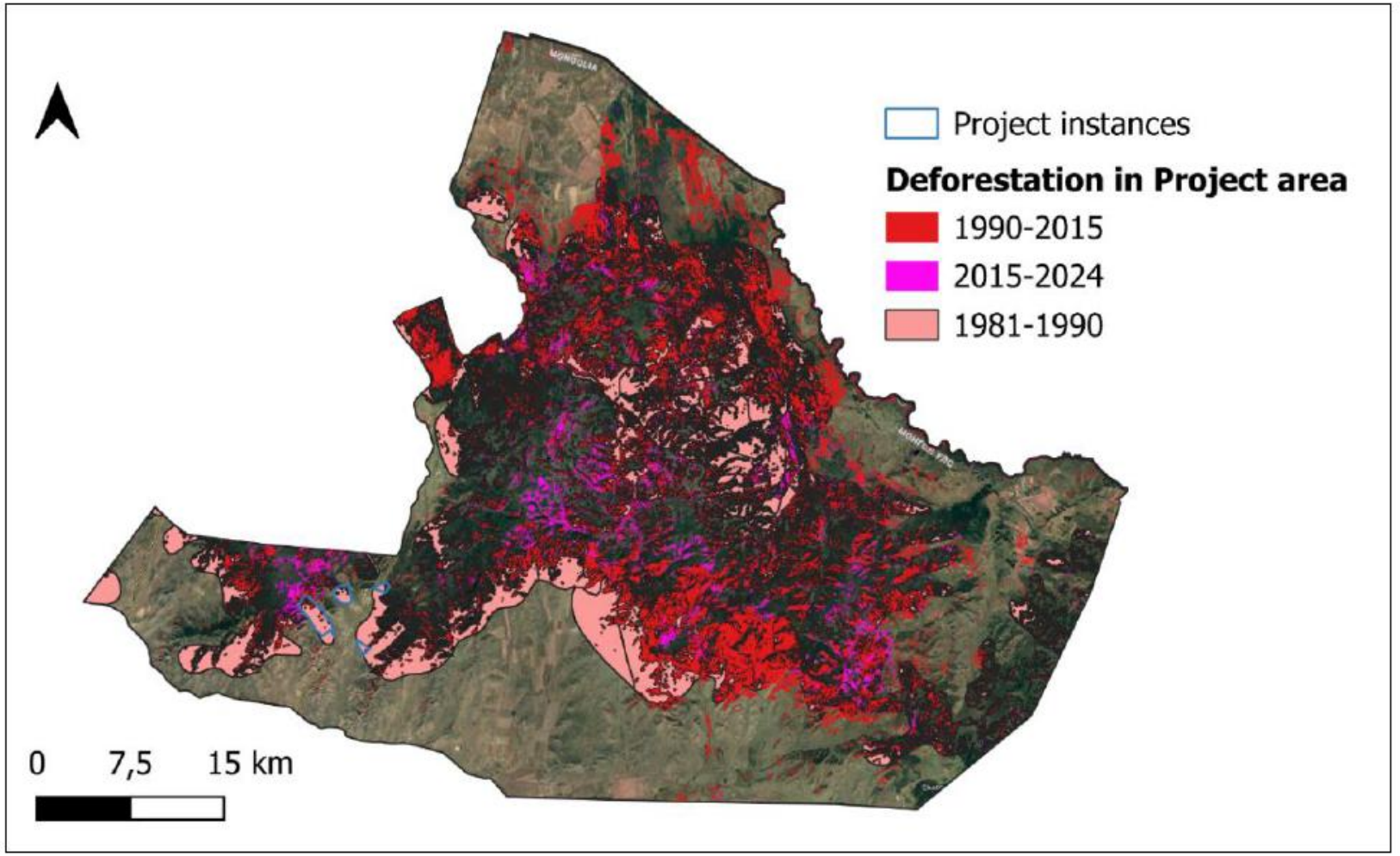
In boreal forests, peaty patches can develop in areas where water accumulates due to topography; however, these patches may not be evident in broader soil data. If any activity instance includes such peaty patches, no non-native species will be planted, in compliance with the VM0047 applicability conditions

Figure 4 Soil map for Project Gamma expansion area and first activity instance (in red)



Source: General Department of Land Management, Geodesy, and Surveying

Figure 5 Deforested area inside project expansion area



Source: Landsat 5, Landsat 8 and Forest cover map 1981 (Forestry Department of the Mongolian Government)

The project does not convert natural, non-degraded ecosystems due to project activities: all activities are primarily carried out in areas which have been **deforested at least 10 years prior.** If deforestation took place less than 10 years ago, evidence will be provided, that deforestation did not occur due to project activity, as required by VCS Standard 4.7, section 3.19.29

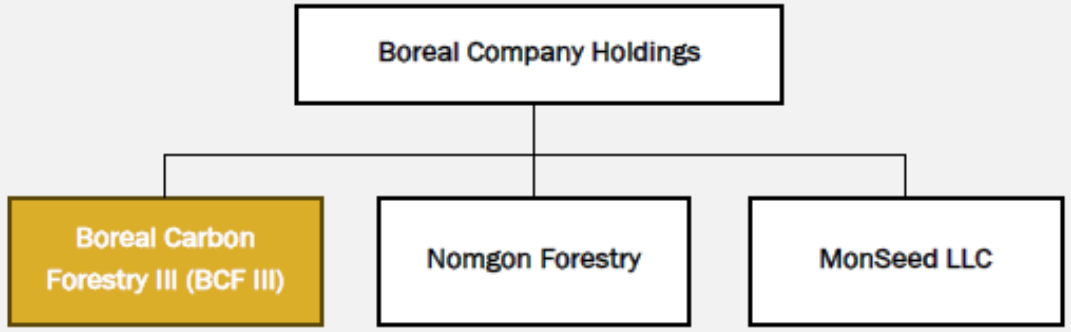
1.5.1 Grouped project design

New project activity instances will be eligible to join the project if they meet the following criteria:

1	Satisfy the applicability criteria described in the VCS Methodology for Afforestation, Reforestation and Revegetation Projects (VM0047), ensuring that the project activities qualify as afforestation, reforestation or revegetation and do not occur in organic soils, wetlands or tidal wetlands.
2	Are located on land covered by a "Cooperation and Stability Agreement" (CSA) with the local government granting Nomgon Forestry the concession to plant and manage the land for at least 60 years.
3	Are located in Selenge Aimag within the project zone.
4	Are previously deforested.
5	Are suitable for reforestation from a biological and geophysical perspective.
6	Have additionality characteristics consistent with initial instances for the specified project activity and geographic area and tree planting is not mandated nor required by any law, statute, or other systematically applied regulatory framework.
7	Are subject to the baseline scenario determined in the project description for the specified project activity (native tree plantation) and specified geographic area.
8	Have consistent financial, technical, and common practices as the initial instances.

1.6 Project Proponent

Organization name



Boreal Carbon Forestry III (BCF III) Pte Ltd is the project proponent. BCF III is a subsidiary of the parent company, Boreal Company Holdings (BCH) Pte Ltd. Both entities are Singaporean

Nomgon Forestry is a local subsidiary of BCH and holds the contractual terms to land use via "Co-operation and Stability Agreements" with local governments (soums). Additionally, Nomgon Forestry has the contractual terms to conduct all necessary activities to prepare, plant and maintain the land.

Project funding is distributed through BCF III to Nomgon as compensation for their role as operator and service provider in support of the project.

How are carbon rights defined in Mongolia?

Can Nomgon Forestry transfer the rights to BCF III?

Land Ownership

- Land ownership in Mongolia is not granted to foreign owned corporate entities. For the first project activity instances (PAIs), Nomgon Forestry has entered into agreements with local governments to manage reforestation and afforestation activities for a period of at least 60 years. **This land has been classified as a "Special Purpose Area" (SPA)** and, as such, cannot be used for any purpose beside reforestation/afforestation. The following activity instances will be under similar contracts.

1.9 Project Start Date

Project start date	26-April-2025
Justification	Start of soil preparation for planting and/or fencing out the first planting sites.

1.10 Project Crediting Period

Crediting period	☐ *Seven years, twice renewable* ☐ *Ten years, fixed* ☒ *Other: 40 years renewable as supported by the VCS Standard v4.6, Section 3.9.3. The project crediting period is the time period for which GHG carbon dioxide removals generated by the project are eligible for issuance as VCUs.*
Start and end date of first or fixed crediting period	01-May-2025 to 30-April-2065

1.11 Project Scale and Estimated GHG Emission Reductions or Removals

Indicate the estimated annual GHG emission reductions/removals (ERRs) of the project:

☒ < 300,000 tCO2e/year (project)

☐ ≥ 300,000 tCO2e/year (large project)

Total estimated ERRs during the first or fixed crediting period	3 904 000
Total number of years	40
Average annual ERRs	97 600

Planting stock & density

Containerized and bare-rooted seedlings are likely to be the main planting stock for Project Gamma. It is possible to plant forest by sowing seeds directly into pre-prepared soil, but the areas suitable for direct seeding are valid exclusively to Scotch pine and severe conditions. Direct seeding of Scotch pine is recommended to be conducted with a density of 2 200–2 800 spots/ha requiring a drop of 10–20 seeds per spot.

For the first four activity instances (PAI1-PAI4), in total 690 ha, bare-rooted seedlings will be planted, as they are available in Selenge.

3 APPLICATION OF METHODOLOGY

3.1 Title and Reference of Methodology

Type (methodology, tool or module).	Reference ID, if applicable	Title	Version
Methodology	VM0047	AFFORESTATION, REFORESTATION AND REVEGETATION	1.0
Module	VMD0054	Module for estimating leakage from ARR activities	1.0
Tool	VT0001	TOOL FOR THE DEMONSTRATION AND ASSESSMENT OF ADDITIONALITY IN VCS AGRICULTURE, FORESTRY AND OTHER LAND USE (AFOLU) PROJECT ACTIVITIES	3.0
Tool		AFOLU Non-Permanence Risk Tool	4.2

3.2 Applicability of Methodology

Methodology ID	Applicability condition	Justification of compliance
VM0047	Project activities increase vegetative cover	The project's main activity is afforestation / reforestation on degraded land through drone, mechanised and manual planting
VM0047	Area based, census based or a combination of the two quantification approaches may be used provided approach-specific applicability conditions are met. Approaches must be selected at the project start date and used for the entire crediting period. Where the two approaches are used together, they must be applied on non-overlapping areas defined at the project start	The area-based approach was selected at the start of the project and will be used for the project duration.
VM0047	Project activities do not involve mechanical removal offsite or burning of significant stocks of existing dead wood (e.g., for preparation). Where project site preparation includes chipping, mastication or machine piling, all material must remain on site within the project boundary	The project will not conduct mechanical removal offsite or burning of significant stocks of existing dead wood. Site preparation will not include chipping, mastication or machine piling. These criteria are stipulated in Boreal Company Holding's Operational Guide.
		stipulated in Boreal Company Holding's Operational Guide.
VM0047	Area-based approach: Projects may include direct planting (e.g., manual planting, broadcast seeding) and indirect activities (e.g., activities that permit or facilitate natural regeneration, like herbivory exclosures)	The project includes both direct (drone, mechanised and manual planting) and indirect (e.g., fencing) activities. These criteria are stipulated in Boreal Company Holding's Operational Guide.
VM0047, performance method, Appendix 1	The project meets all applicability conditions detailed in Section 4 of this methodology.	All conditions are met, please see above.
VM0047, performance method, Appendix 1	The project activities will produce continuous vegetative cover on any continuous area exceeding one hectare allowing for clear spatial delineation the project area	Project activities will have clear delineation and cover a contiguous area exceeding 1 hectare
VM0047, performance method, Appendix 1	The project performance benchmark must be updated at each verification or every five years, whichever comes first	The project's performance benchmark will be updated at each verification or every five years, whichever comes first
VMD0054 Module for estimating leakage from ARR activities	Projects using this module must meet all applicability conditions of the methodology VM0047 Afforestation, Reforestation and Revegetation.	Project meets all the VM0047 applicability conditions.
VT0001 Tool for the demonstration f additionality in AFOLU project activities	AFOLU activities the same or similar to the proposed project activity on the land within the proposed project boundary performed with or without being registered as the VCS AFOLU project shall not lead to violation of any applicable law even if the law is not enforced	No activity will violate any law.

Discussion and Q&A

- - What barriers exist to AR project development in Mongolia?
- - What role should government agencies play?
- - How can BTNM and VCM be mutually reinforcing?

Conclusion

- **VM0047** represents a significant advancement for **nature-based carbon removal initiatives**.
- It promotes **high-integrity carbon accounting** through its robust and technologically advanced methodologies.
- This standard strongly supports global efforts in **afforestation, reforestation, and revegetation** as vital tools for climate action.

Costs and Financing of AR Projects

- - Upfront costs: site prep, planting, monitoring
- - Sources: carbon buyers, impact investors, grants
- - Revenue through carbon sales or co-benefits

Long-Term Monitoring and Safeguards

- - Monitoring must continue over project lifetime (20–40+ years)
- - Fire, pests, grazing risks must be addressed
- - Safeguards: legal protection, community agreements

Social and Biodiversity Co-benefits

- - Improved livelihoods via jobs and benefit-sharing
- - Rebuilding native habitat and protecting wildlife corridors
- - Co-certification: CCB Standards, SD Vista

BTNM and VCM: Strategic Synergies

- - Use VCM finance to complement Billion Tree targets
- - Apply VM0047 to quantify and credit planting efforts
- - Create incentives for sustainable reforestation

Thank You and Next Steps

- - Contact info for follow-up
- - Encourage agency-led pilot project development
- - Open floor for final Q&A