Forest Carbon Sequestration:
Issues and Challenges

DOI NRDAR Workshop
March 30th 2011

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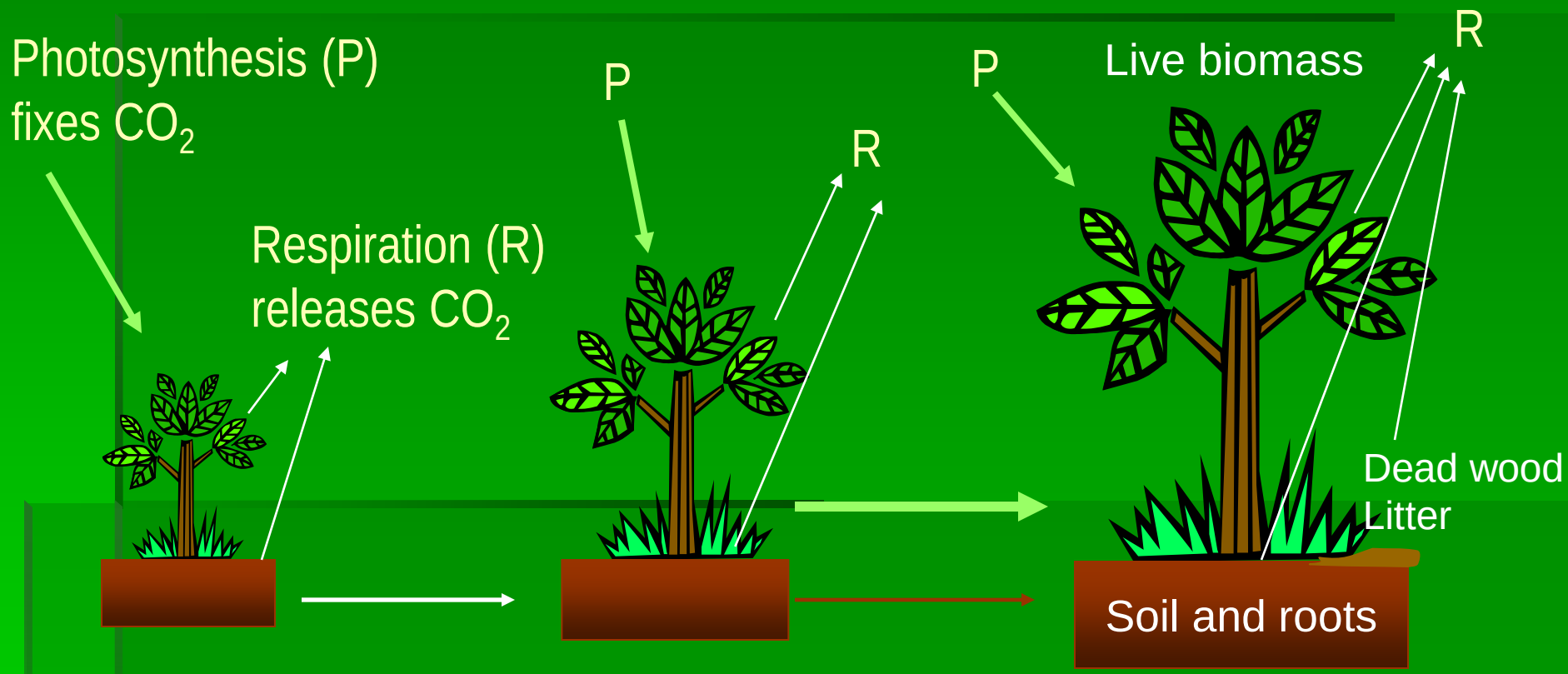
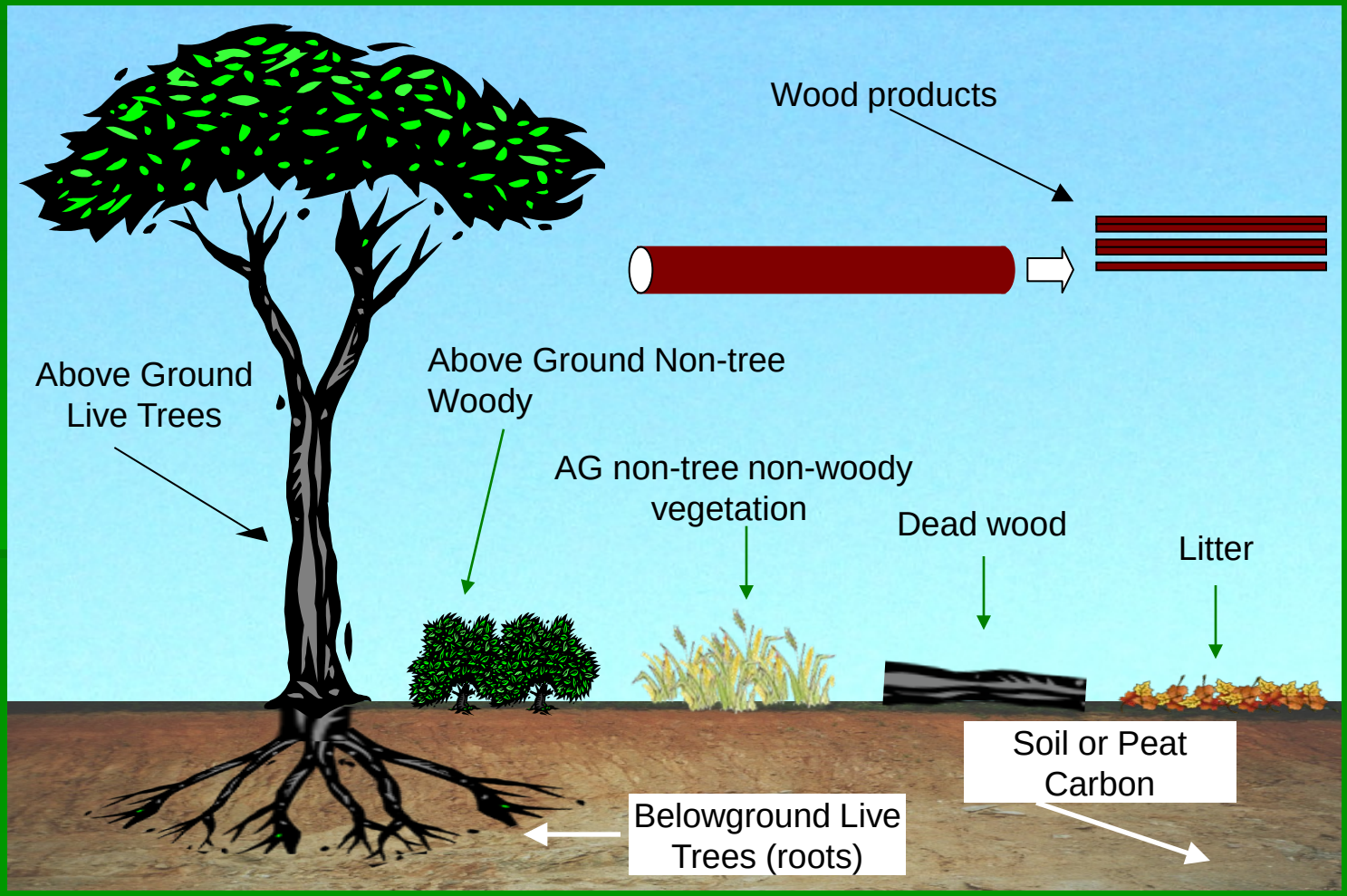
Winrock International

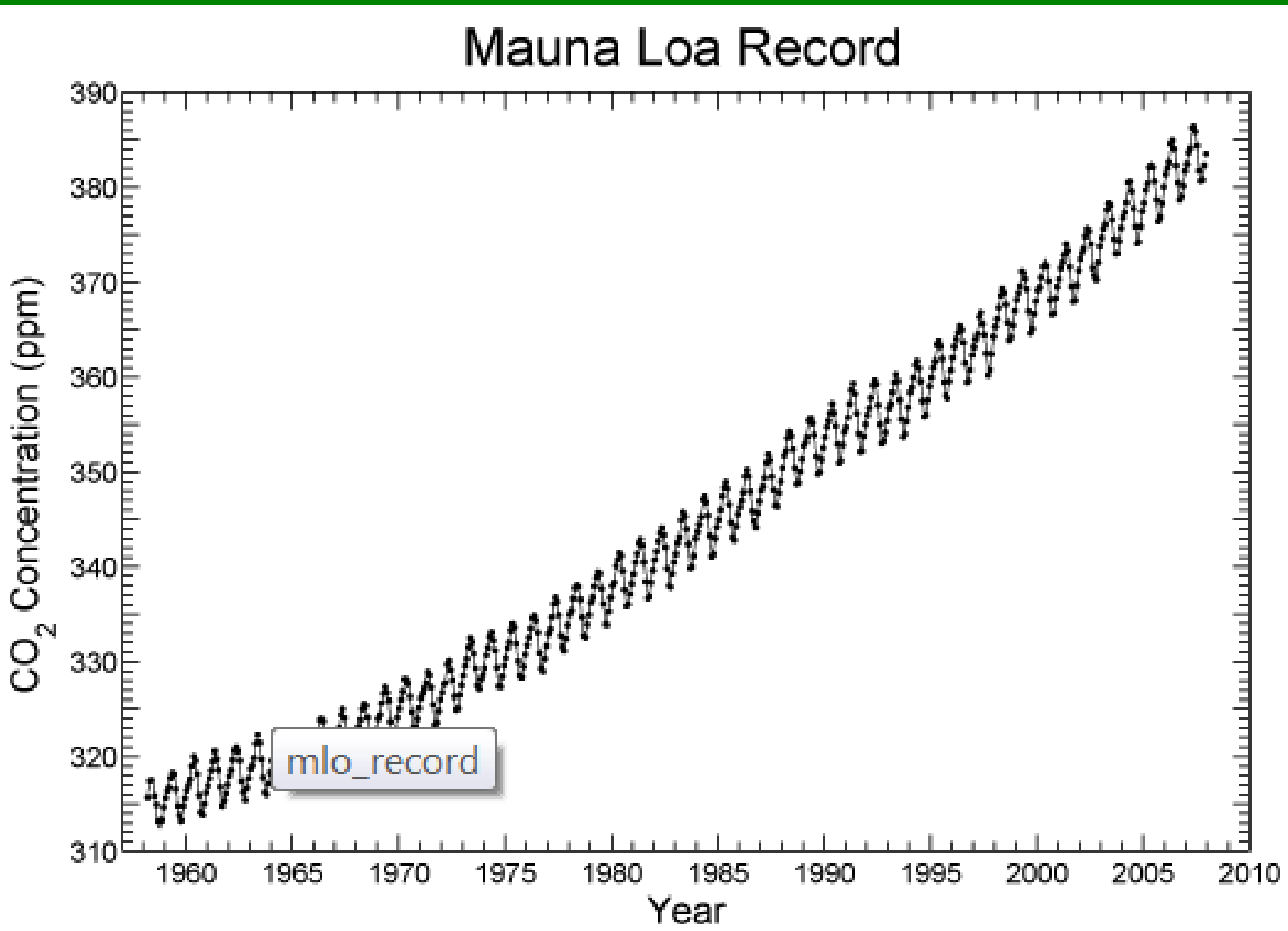
Carbon sequestration



Photosynthesis exceeds respiration, resulting in storage of carbon

Carbon pools



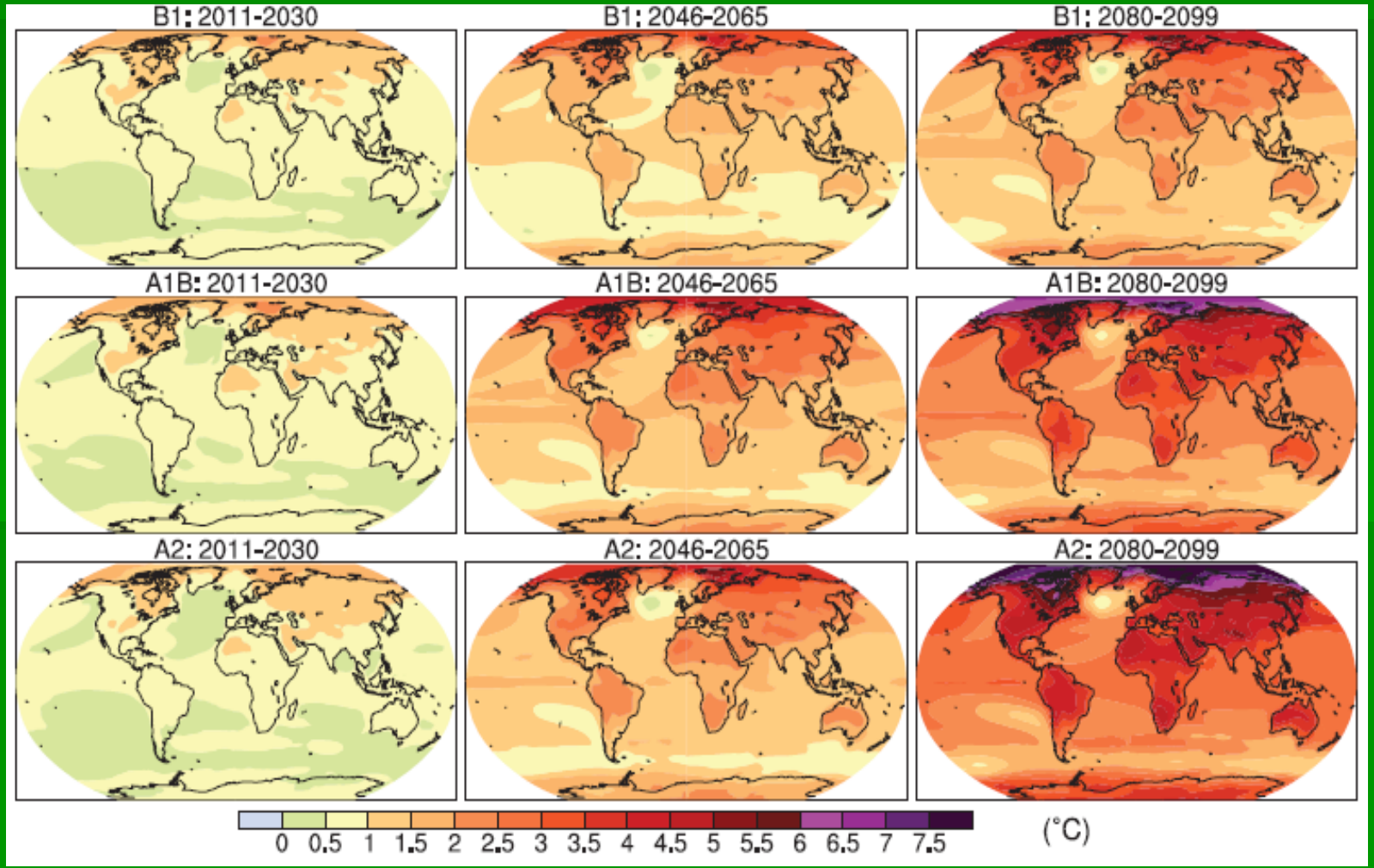

Mauna Loa Record
CO_2 Concentration (ppm)
390
380
370
360
350
340
330
320
310
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year
mlo_record

Projected mean annual surface warming

Low

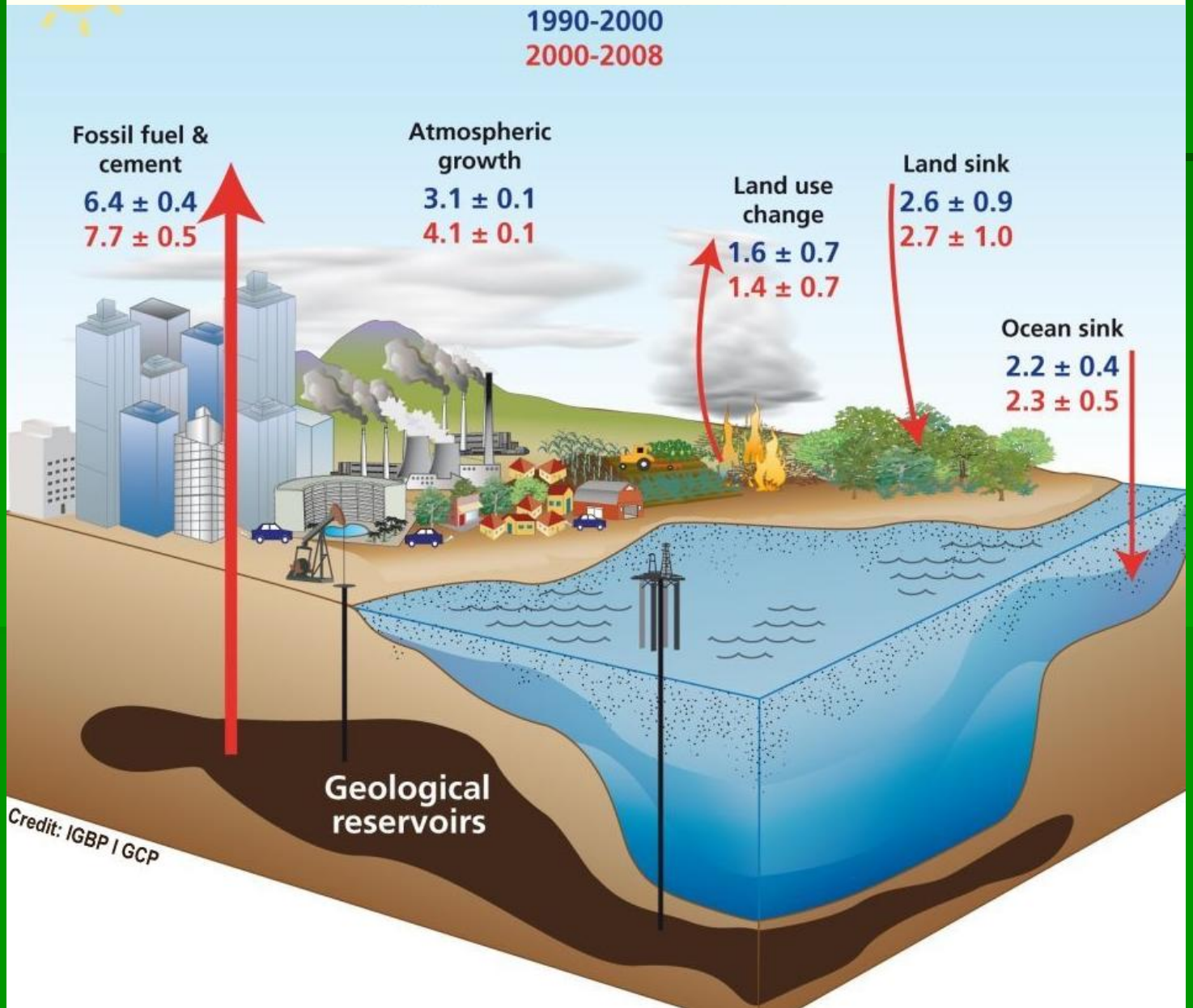
Medium

High



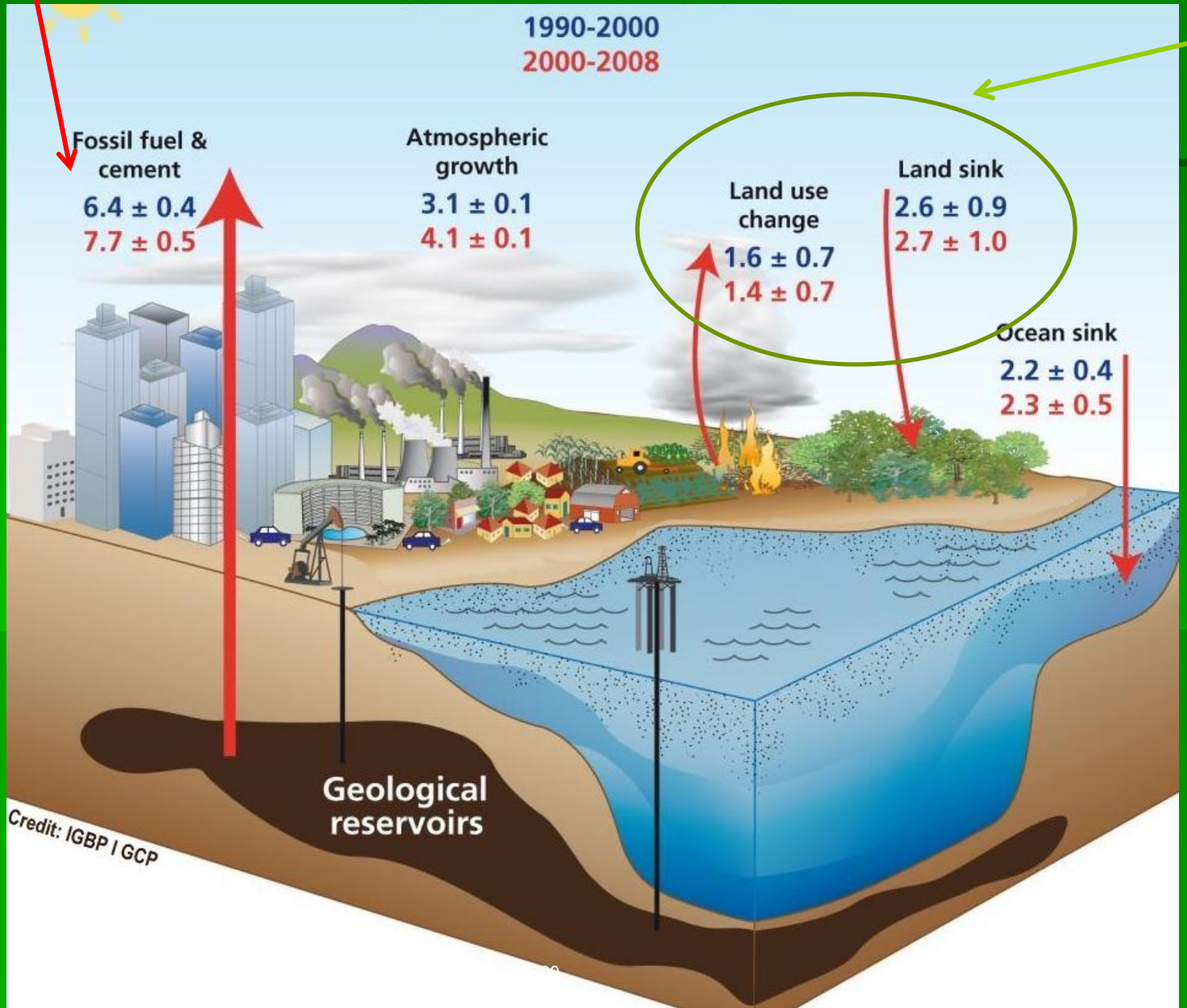
Based on multiple models –Ch 10 in IPCC 4th Assessment Report

Global Carbon Budget
(Billion metric tons per year)



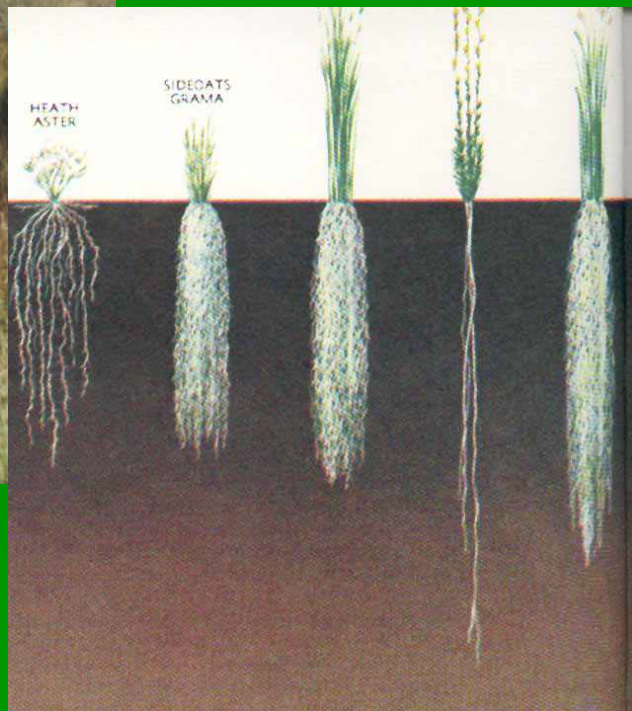
Humans can reduce emissions with clean energy and energy efficiency

Humans can manage lands to reduce sources and enhance sinks to mitigate emissions



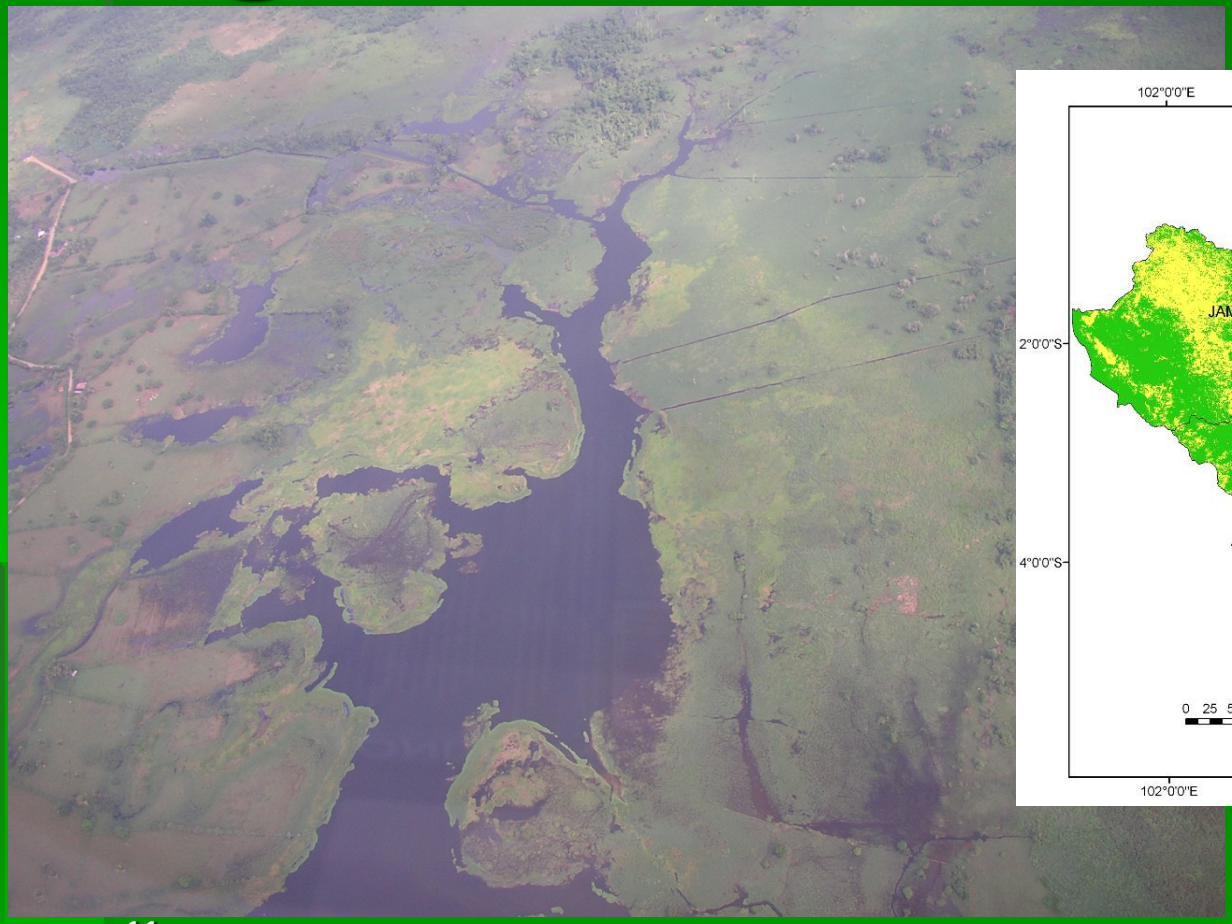
Afforestation / Reforestation

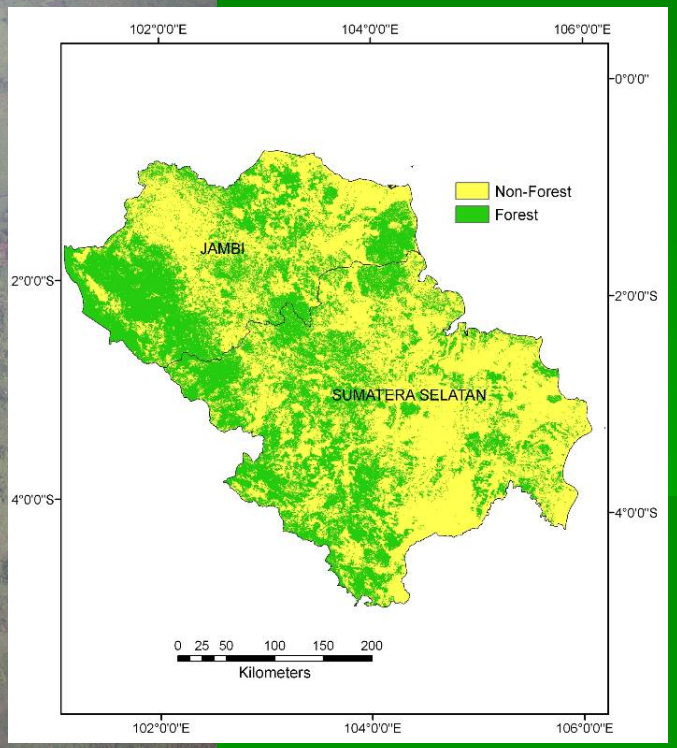
Grassland Restoration



Improving Forest Management

Reducing Emissions from Deforestation and Degradation

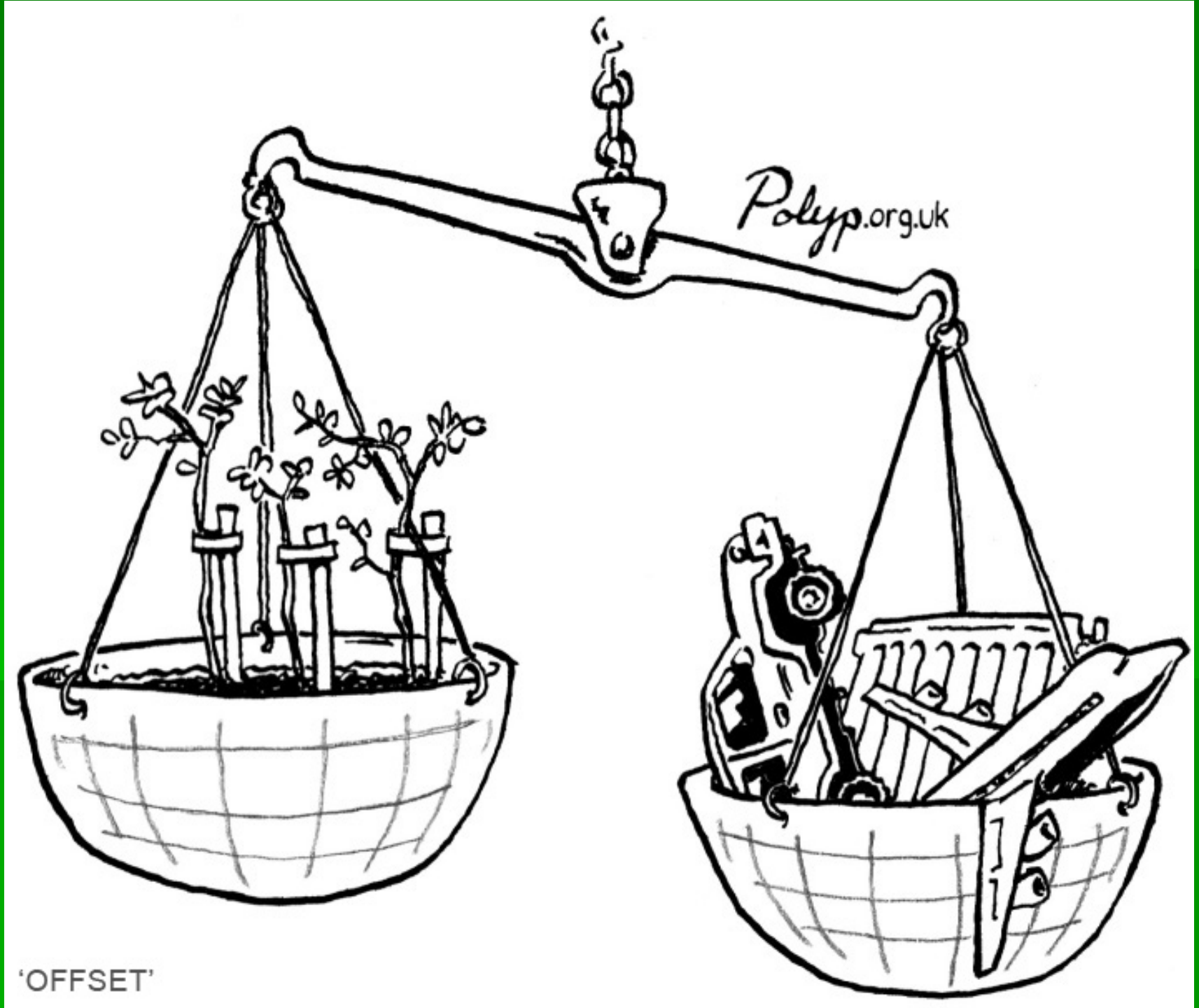




Agricultural Land Management

How much can be stored?

- Forests:
  - Annual sequestration: up to 3 t C per ac per yr
  - Stock after 50 years: 25 – 150 t C per ac
- Grasslands:
  - Annual sequestration: up to 1 t C per ac per yr
  - Stock after 50 years: 8 – 75 t C per ac



'OFFSET'

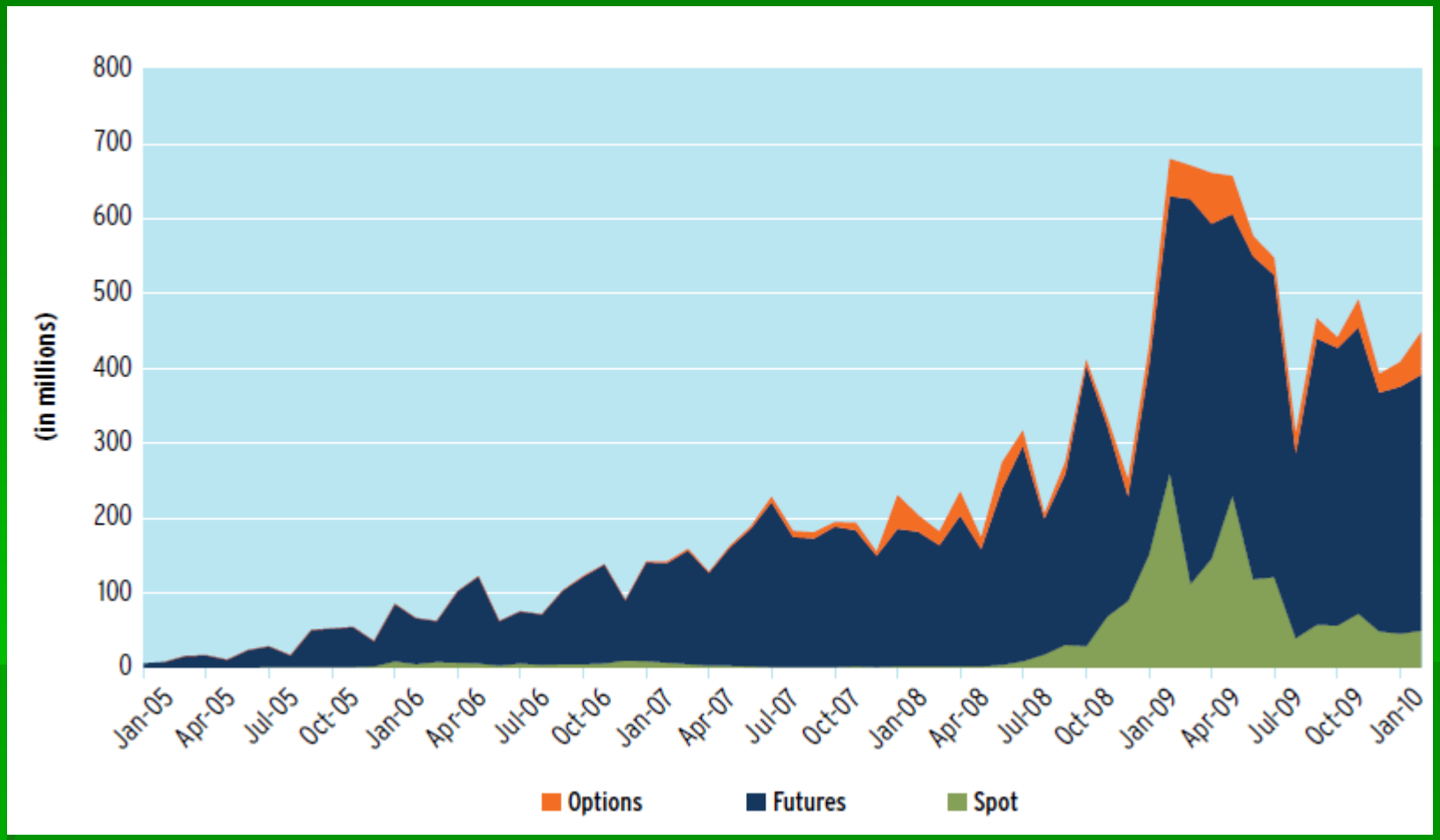
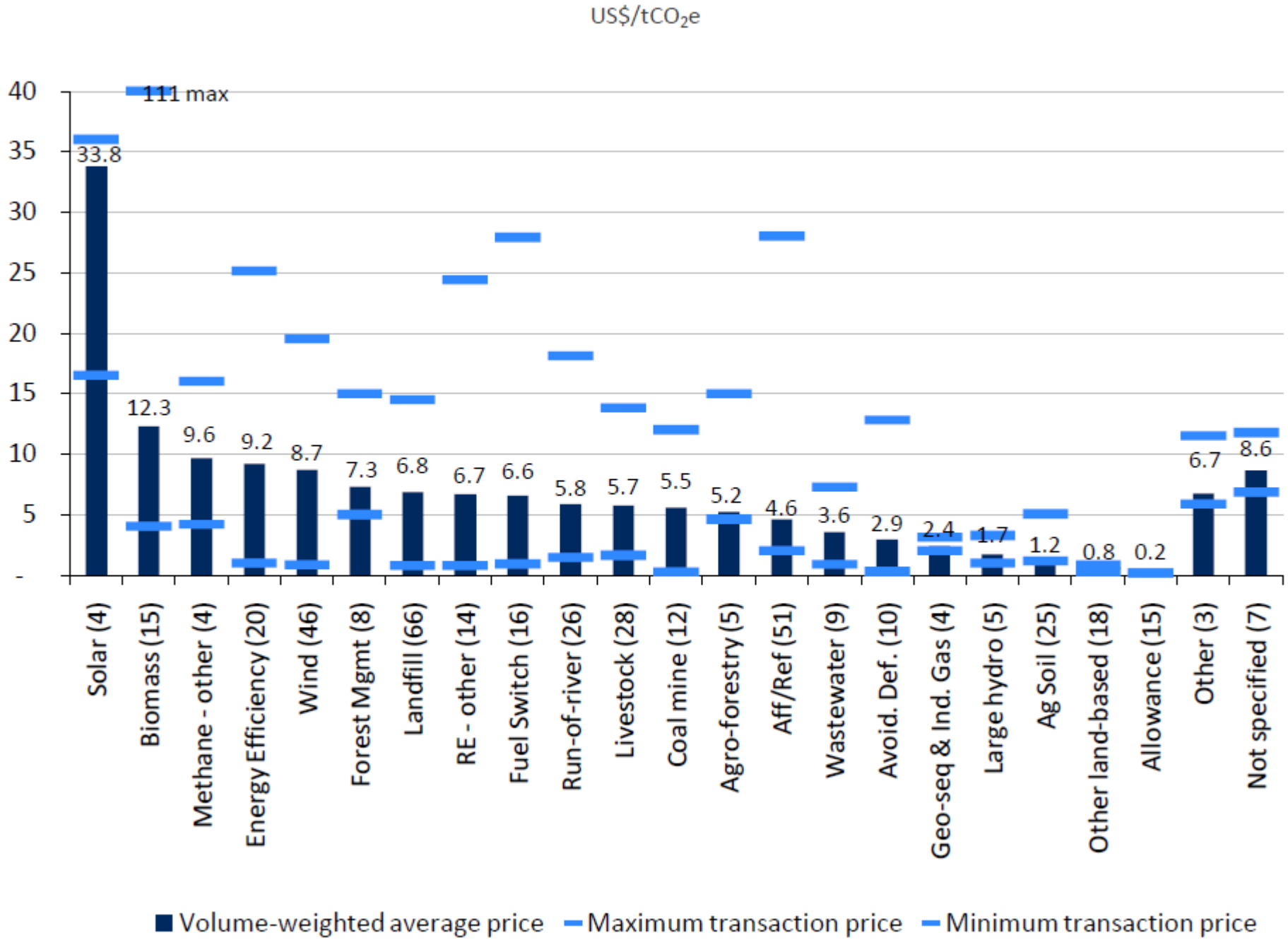

800
700
600
500
400
300
200
100
0
(in millions)
Jan-05
Apr-05
Jul-05
Oct-05
Jan-06
Apr-06
Jul-06
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Jan-10
Options
Futures
Spot

Figure 3: Average Credit Price and Price Range by Project Type, OTC 2009



KEY ISSUES FOR CARBON PROJECTS

Basic requirements of emissions reductions or removals

- Real, measurable
- Long-term
- Additional
- Certified

→ Emissions savings should be permanent or effectively permanent

→ BAU activities not eligible, must be human-induced

→ Validation, Verification, and Certification by accredited entity

Concepts for Land Use Carbon Projects

- Additionality
- Baselines
- Leakage
- Non-permanence

Additionality

- A project is additional if the activity only takes place **because of the anticipation of a potential sale** of carbon credits

- An activity such as forest restoration would not have taken place without anticipation of income associated with receiving carbon offsets

Additionality

- Legal additionality
- Financial additionality
- Biological additionality

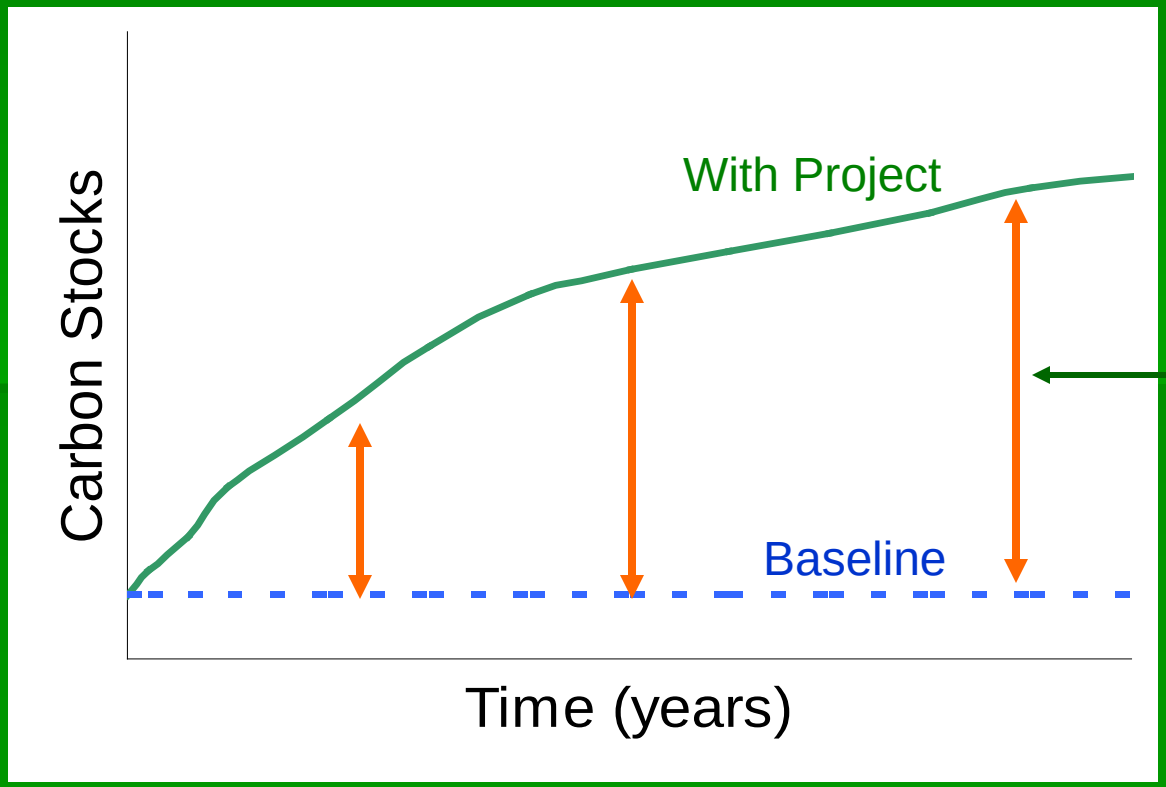
Baselines

- What would have happened in the absence of the restoration activity
- Must be *transparent* and *conservative*

Baselines – example:

- Credits from a project is:

  Difference between C stocks with project and baseline C stocks

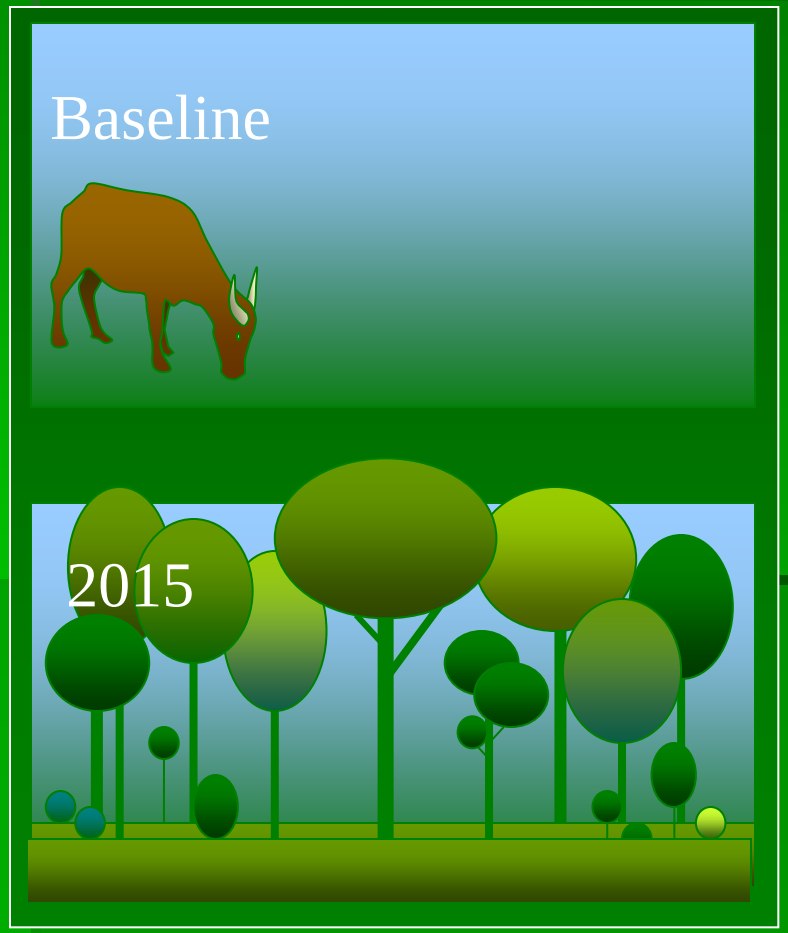


Leakage

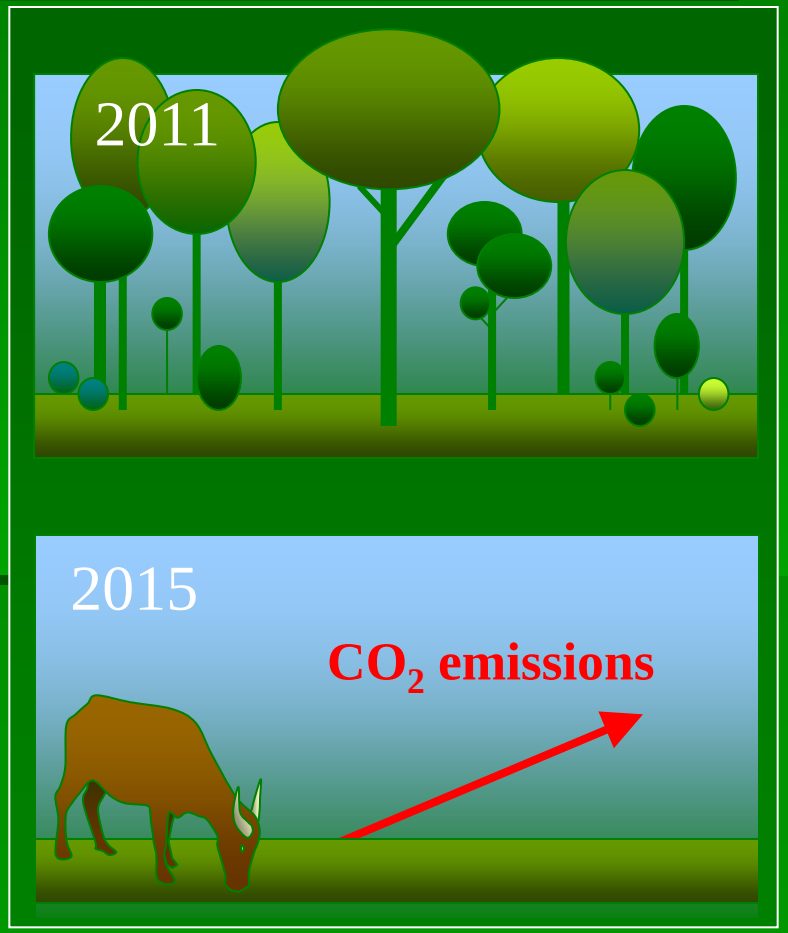
- Leakage is the unanticipated loss in carbon benefits outside of the project's boundary as a result of the project activities
- Carbon emissions from leakage could undo gains from a carbon project, resulting in a reduction in the positive greenhouse gas impact

Leakage – A/R example

Project Area

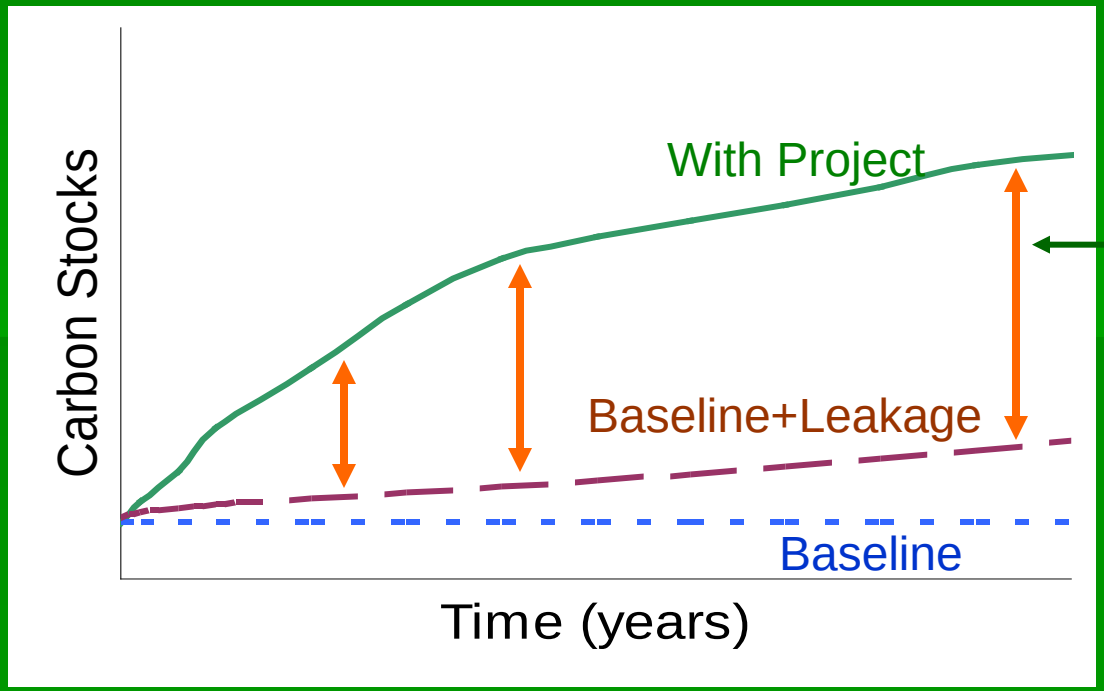


Nearby the Project Area



Leakage – example

- Carbon credits
  = Project – Baseline – Leakage



Non-permanence

- Carbon stored in trees, grasses and in the soil is not permanent
- Trees can be cut down, grasslands can be ploughed
- Addressed by:
  - Concept of “rental” of the service
  - Legal guarantees
  - Insurance against reversal

The Carbon Market Today

The Carbon Market Today?

- Kyoto Protocol – Clean Development Mechanism
- RGGI – northeast power generation
- Upcoming regulation in California
- The Voluntary Market

Voluntary Market

- Climate Action Reserve
- American Carbon Registry
- Verified Carbon Standard

- Pre-compliance/PR actions

Voluntary Market Buyers

- Corporate
  - Corporate social responsibility
  - Marketing
  - US Companies anticipating future regulation
- Non-profits
- Events
- Individuals

Issues for Restoration Projects

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ADDITIONALITY AND BASELINES

- Restoration that is legally mandated is not additional
- Would be considered business as usual

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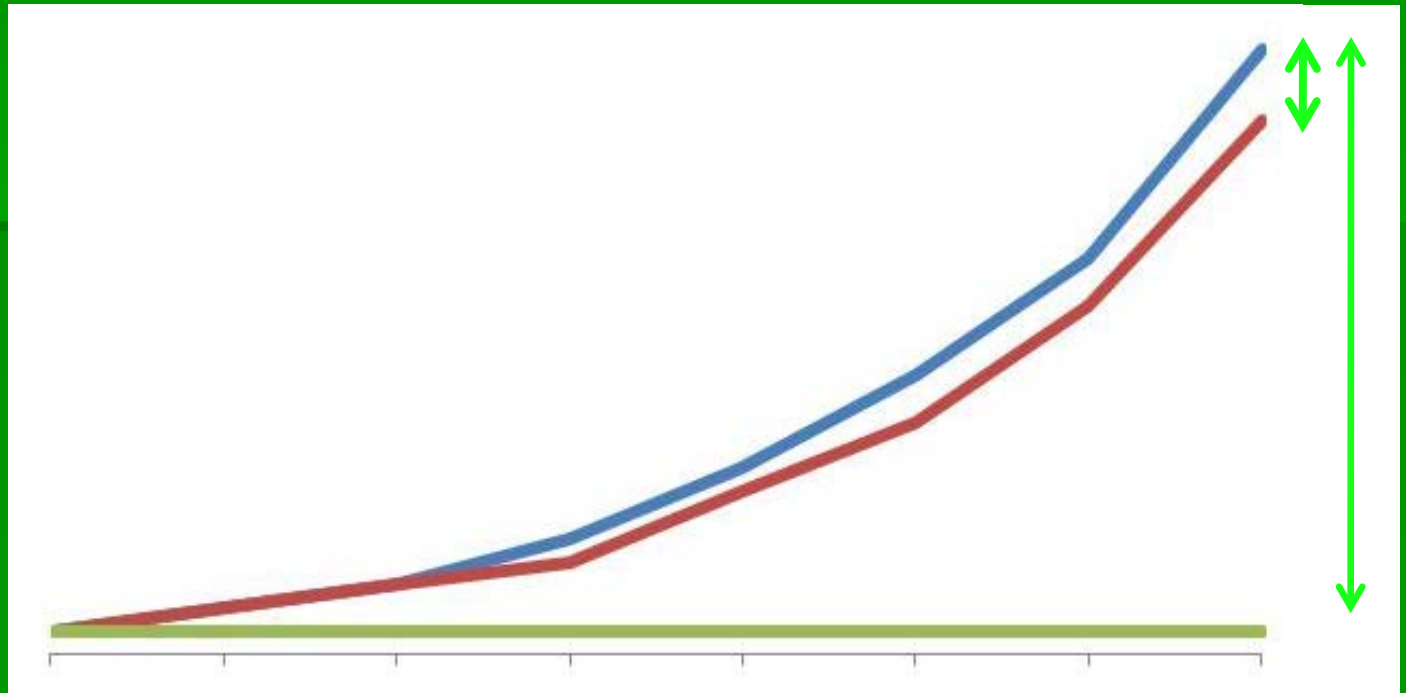
ADDITIONALITY AND BASELINES

- Restoration that is legally mandated is not additional
- Would be considered business as usual
- The atmosphere sees the greenhouse gas benefit regardless of whether or not carbon payments occur
- So to be additional would have to go beyond what is legally required

Issues for Restoration Projects

BASELINE: If restoration goes beyond the mandate all that would be creditable is the increase above the mandate



Issues for Restoration Projects

- LEAKAGE: Likely not to be a leakage risk
- PERMANENCE: Likely a low risk to permanence

- All issues are only relevant if market registration is going to be sought

Choices for Restoration Projects

Choices for Restoration Projects

Developer motivation:

1. Corporate social responsibility / marketing
2. Pre-compliance learning
3. Market registration / offset issuance

Choices for Restoration Projects

1. Reporting carbon impact for internal reasons – corporate social responsibility, marketing
   - Accounting can be determined by the restorer and no set rules need be followed

Choices for Restoration Projects

2. Pre-compliance learning
   - Compliance rules should be followed to maximize lessons and developed expertise
   - Reporting for marketing can be at the restorer's discretion

Choices for Restoration Projects

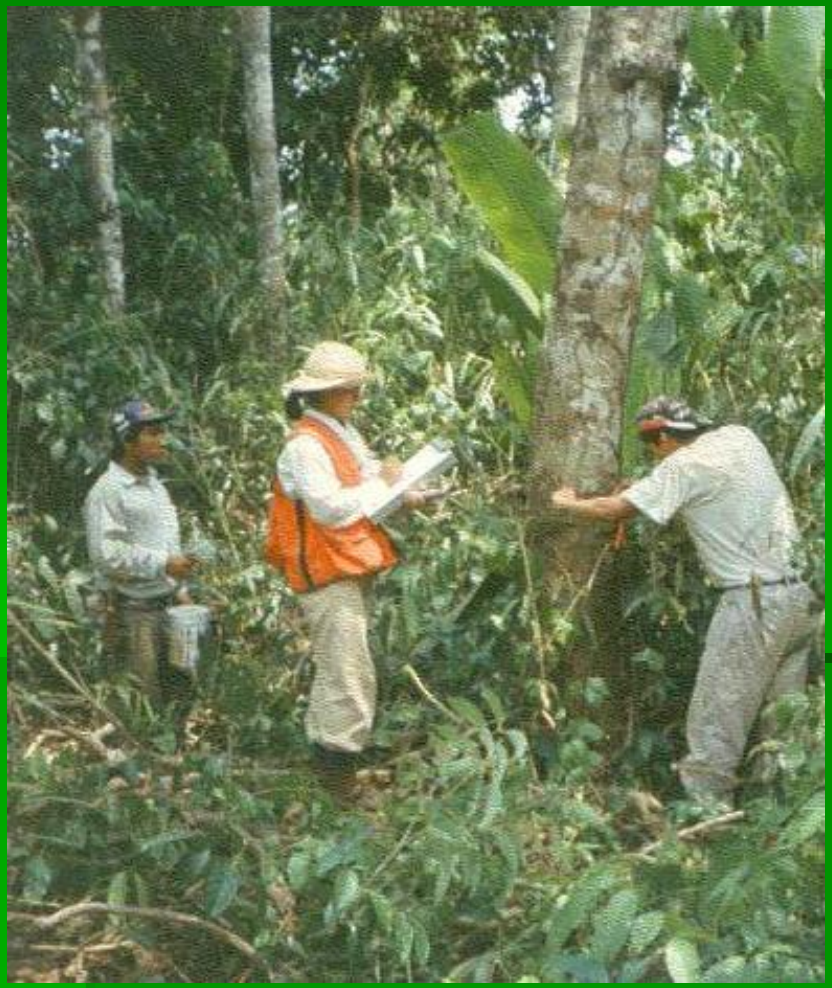
3. Official carbon market registration
   - Exact market rules will have to be followed including going beyond legal mandate and only receiving credit for sequestration above and beyond mandate

Accounting Techniques

Measurement occurs in plots

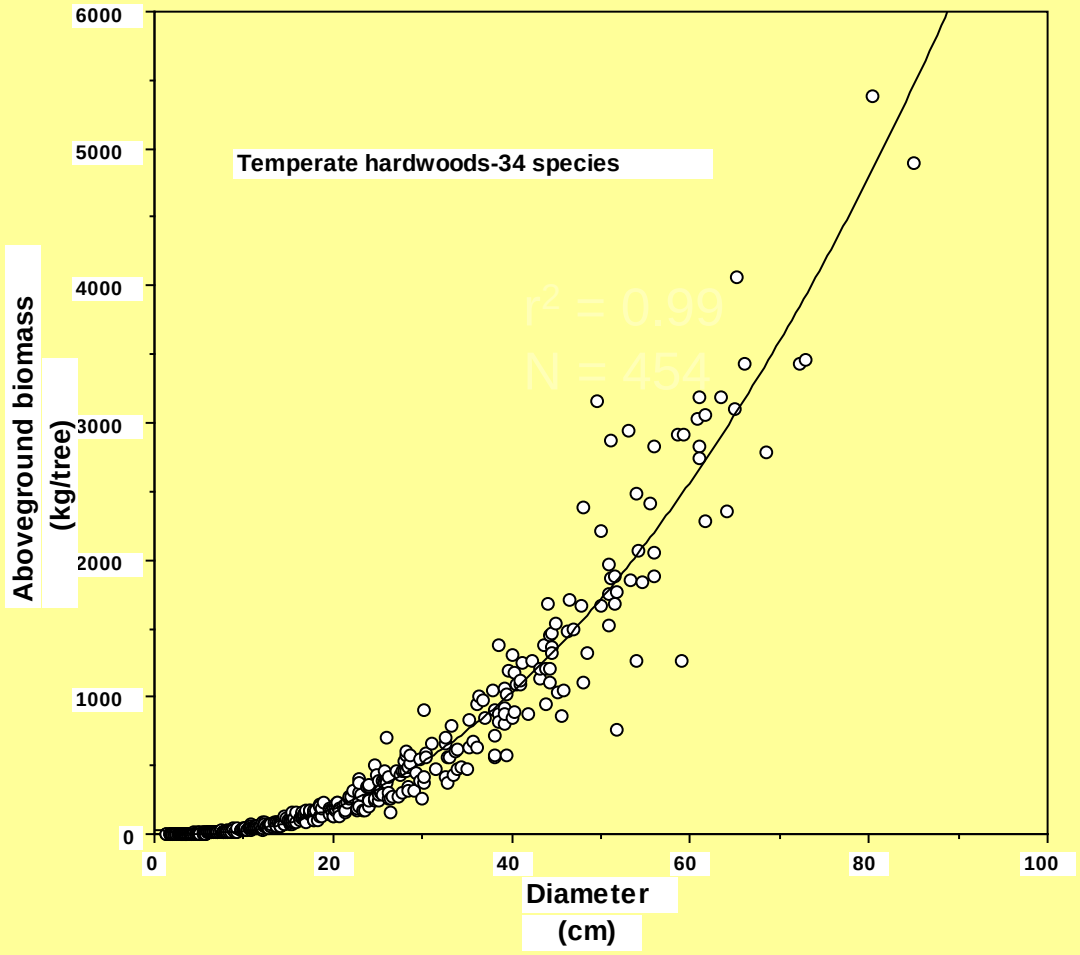
Plot center typically permanently marked and trees tagged

Aboveground Tree Biomass



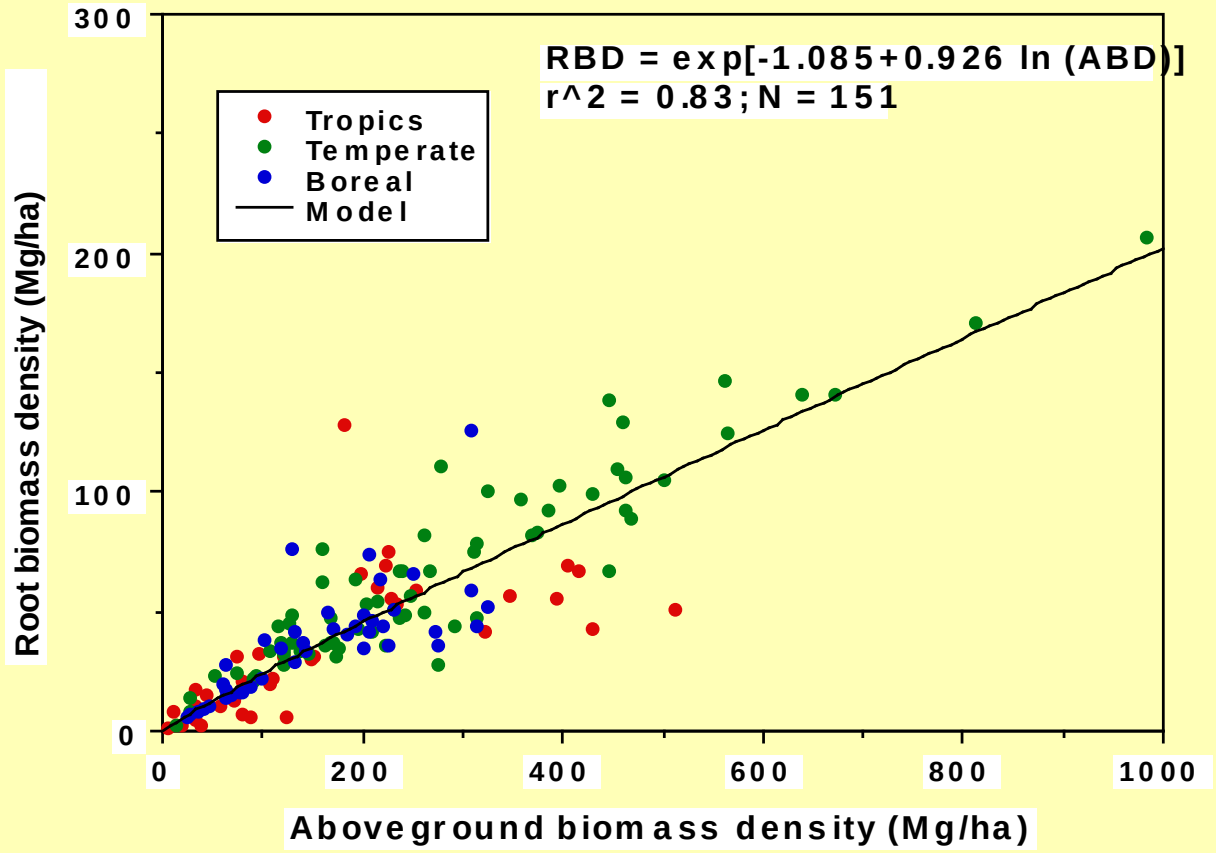
- In plots trees measured (typically DBH)

Aboveground tree biomass – Allometric equations



(Schroeder et al. 1997)

Root biomass



Other pools

1. Default approach – look up tables
2. Modeling
3. Measurement

Measurement of dead wood

- Dead wood can be a significant component of biomass pools
- Standing dead in plots
- Down dead wood along transects

Measuring understory / herbaceous vegetation

- Uses small frames
- Cut all herbaceous vegetation, remove leaf litter, within the frame

Aluminum or PVC frame of ~60 cm^2 is placed on the ground

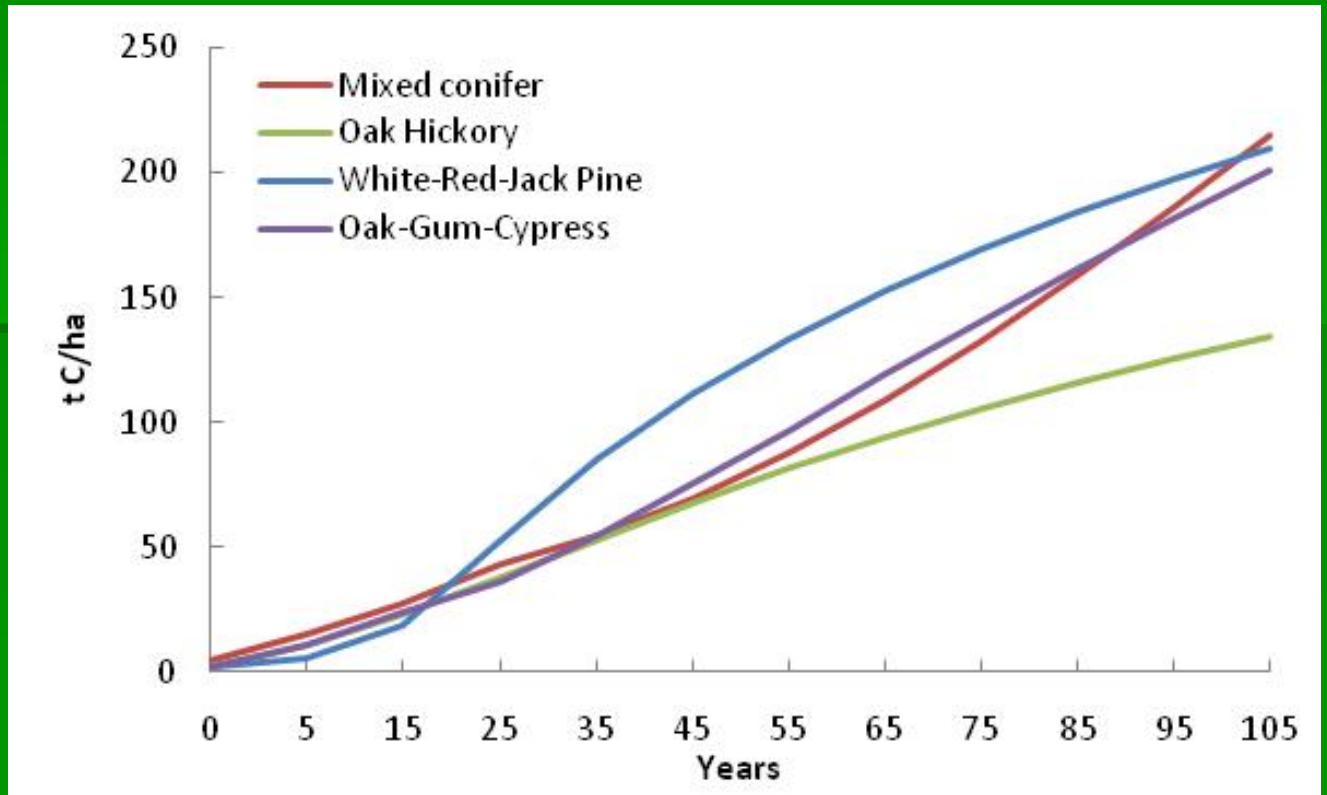
Measuring soil organic carbon

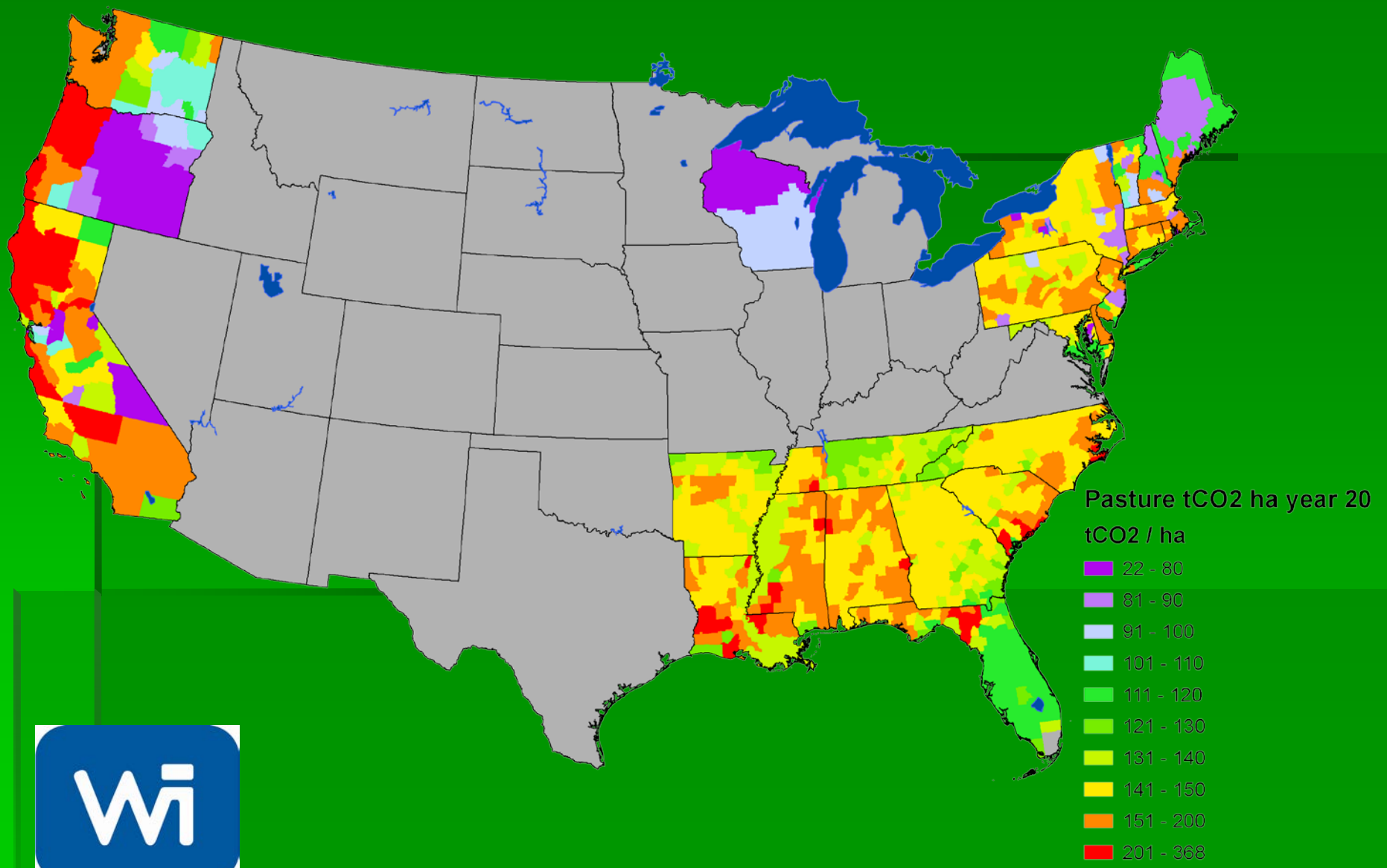
- Uses a soil probe to collect soil cores
- Multiple core samples
- Samples analyzed in a laboratory

Thinking of a carbon project?

Thinking of a carbon project?

- Not all forests are equal
  - Generally faster growing trees will mean faster carbon sequestration




Pasture tCO2 ha year 20
tCO2 / ha
22 - 80
81 - 90
91 - 100
101 - 110
111 - 120
121 - 130
131 - 140
141 - 150
151 - 200
201 - 368

Thinking of a carbon project?

- Decide before starting the ultimate purpose for design
  - Principally carbon sequestration
  - Or habitat restoration, biodiversity, watershed protection etc.

Thinking of a carbon project?

- Design should seek to avoid emissions that may decrease future benefits
  - e.g. measures to avoid wildfire losses – fuel treatments, fire breaks

Project Cycle (carbon market registration)

1. Initial consultation / PIN to determine go/no go
2. Data collection/analysis
   a. Existing stocks
   b. Projected growth
   c. Projected baseline
3. Prepare project documentation (PDD)
4. Registration
5. Monitoring
6. Verification

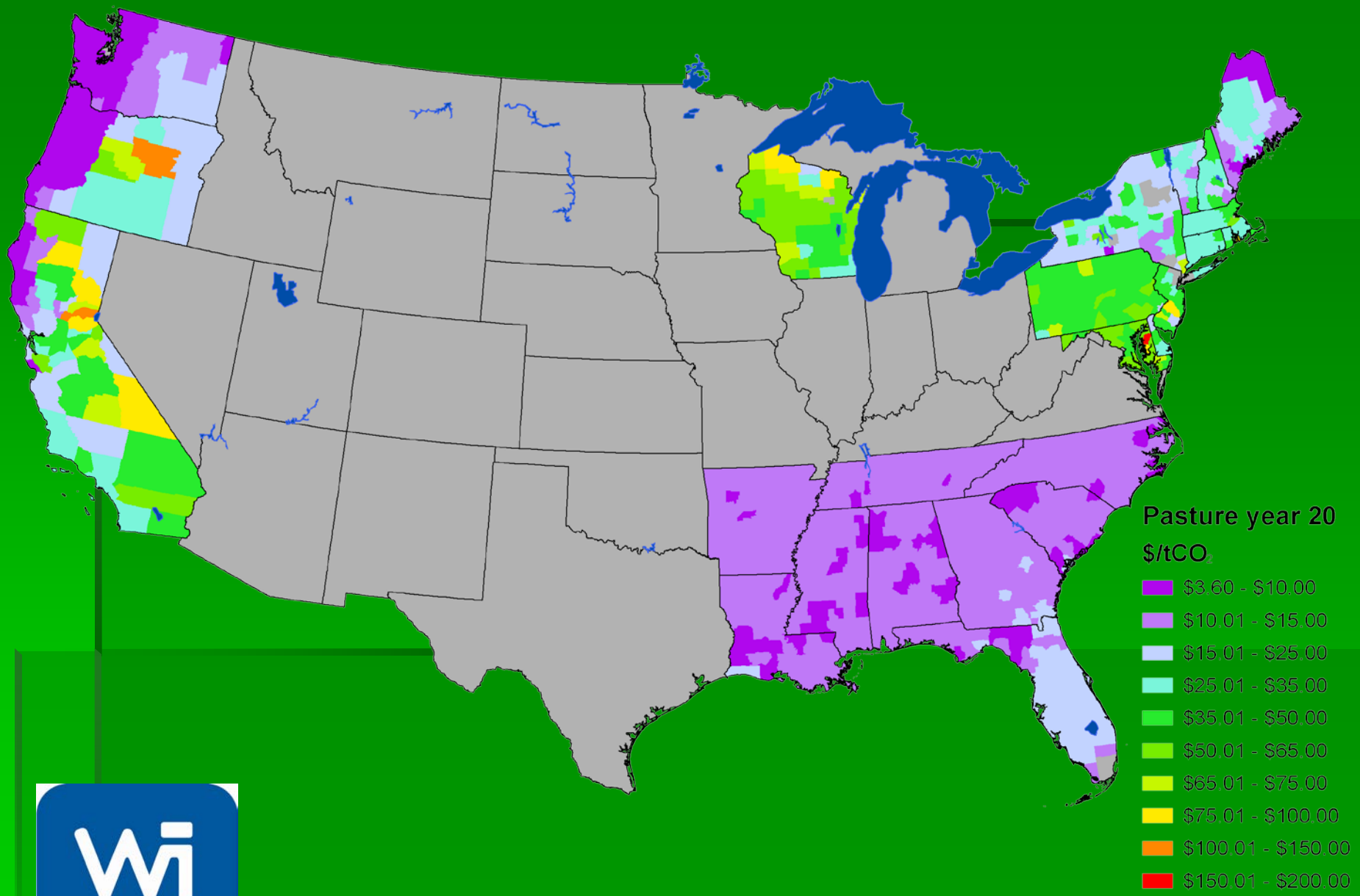
Project Cycle (no registration)

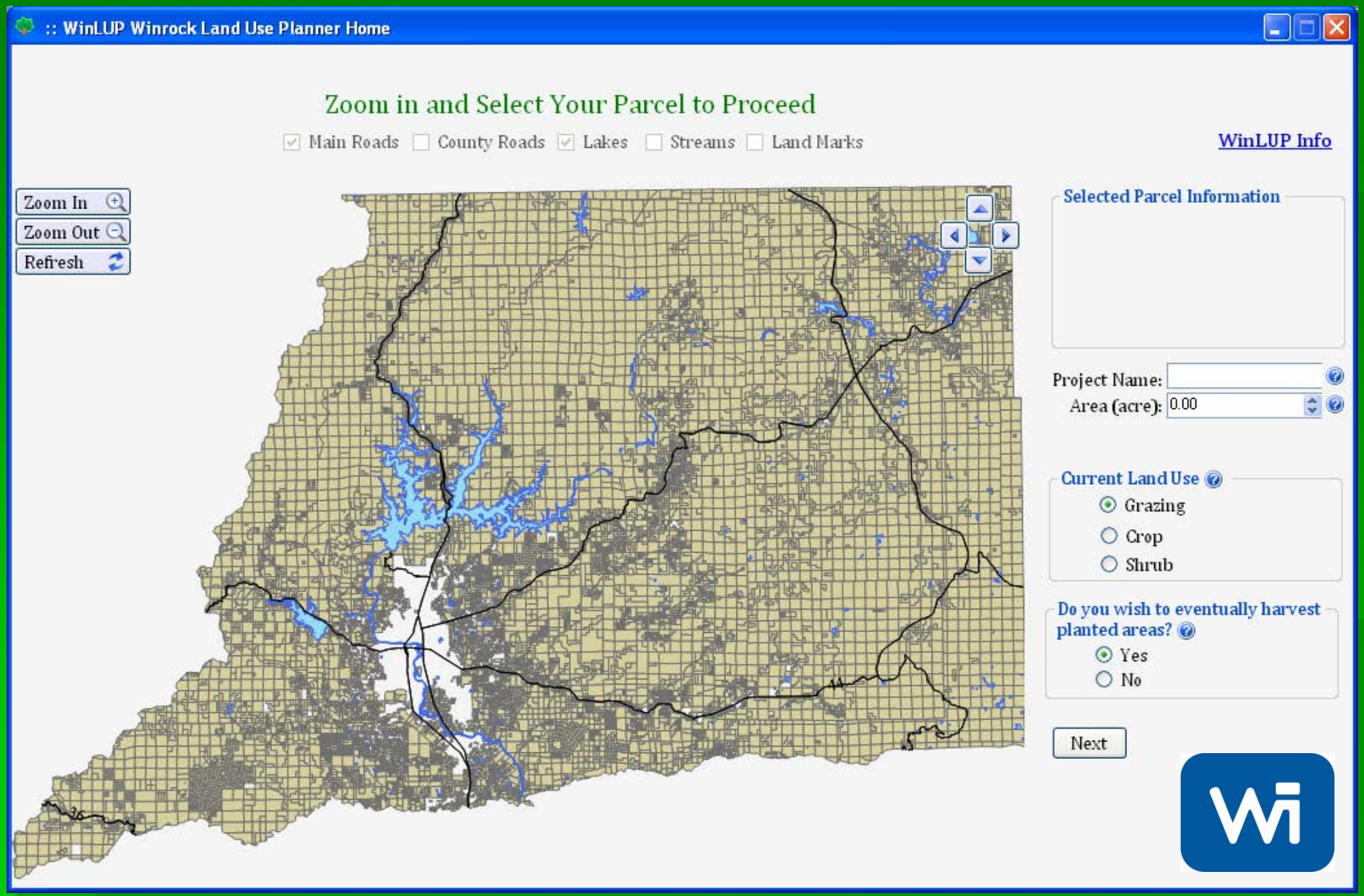
- Initial desk analysis of baseline and projected sequestration through time
- Monitoring?
- Verification?

Carbon Project Costs?

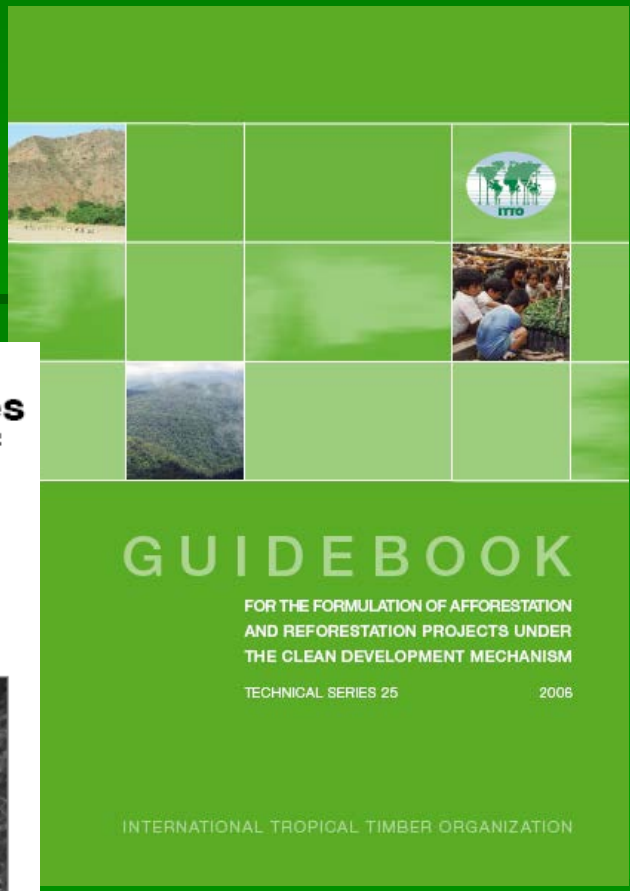
- Consultant to support project through to registration - $40-60,000
- Data collection/Document preparation - $50-150,000
- Monitoring - $5-15,000 per event
- Verification - $30,000 every 5 years

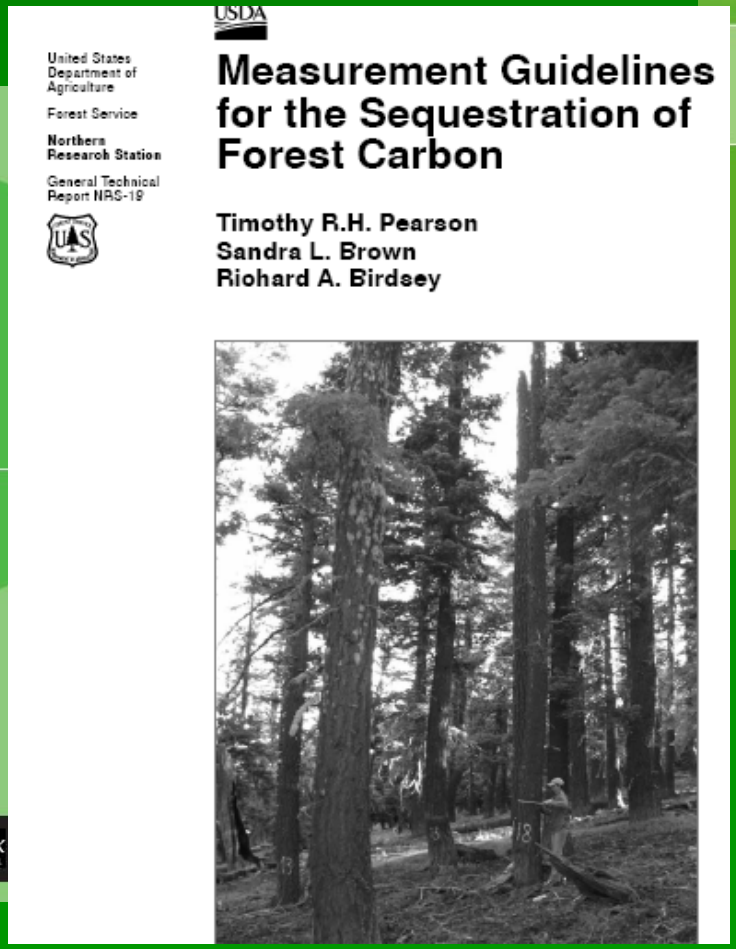
- VALUE OF AGGREGATION

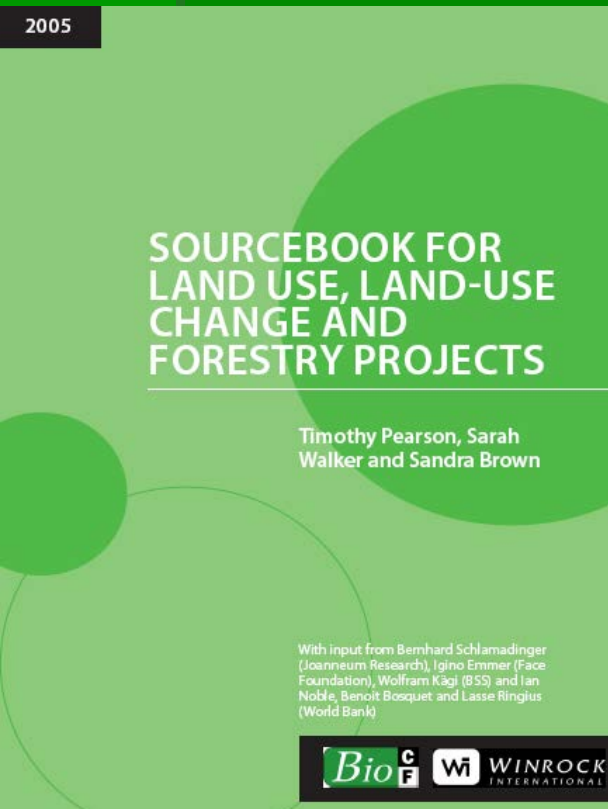

Pasture year 20
$/tCO2
$3.60 - $10.00
$10.01 - $15.00
$15.01 - $25.00
$25.01 - $35.00
$35.01 - $50.00
$50.01 - $65.00
$65.01 - $75.00
$75.01 - $100.00
$100.01 - $150.00
$150.01 - $200.00


:: WinLUP Winrock Land Use Planner Home
Zoom in and Select Your Parcel to Proceed
Main Roads
County Roads
Lakes
Streams
Land Marks
WinLUP Info
Zoom In
Zoom Out
Refresh
Selected Parcel Information
Project Name:
Area (acre):
0.00
Current Land Use
Grazing
Crop
Shrub
Do you wish to eventually harvest planted areas?
Yes
No
Next

Guidebooks


GUIDEBOOK
FOR THE FORMULATION OF AFFORESTATION AND REFORESTATION PROJECTS UNDER THE CLEAN DEVELOPMENT MECHANISM
TECHNICAL SERIES 25
2006
INTERNATIONAL TROPICAL TIMBER ORGANIZATION


USDA
United States Department of Agriculture
Forest Service
Northern Research Station
General Technical Report NRS-19
Measurement Guidelines for the Sequestration of Forest Carbon
Timothy R.H. Pearson
Sandra L. Brown
Richard A. Birdsey


2005
SOURCEBOOK FOR LAND USE, LAND-USE CHANGE AND FORESTRY PROJECTS
Timothy Pearson, Sarah Walker and Sandra Brown
With input from Bernhard Schlamadinger (Joanneum Research), Igino Emmer (Face Foundation), Wolfram Kägi (BSS) and Ian Noble, Benoit Bosquet and Lasse Ringius (World Bank)
BioCF
WINROCK INTERNATIONAL

Thank You!

- For more information see:
  - http://www.winrock.org/Ecosystems/
- Or contact me:
  - tpearson@winrock.org