Accounting Framework for Biogenic CO_2 Emissions

Presentation to

EPA Science Advisory Board

October 25, 2011

What is the purpose of this study?

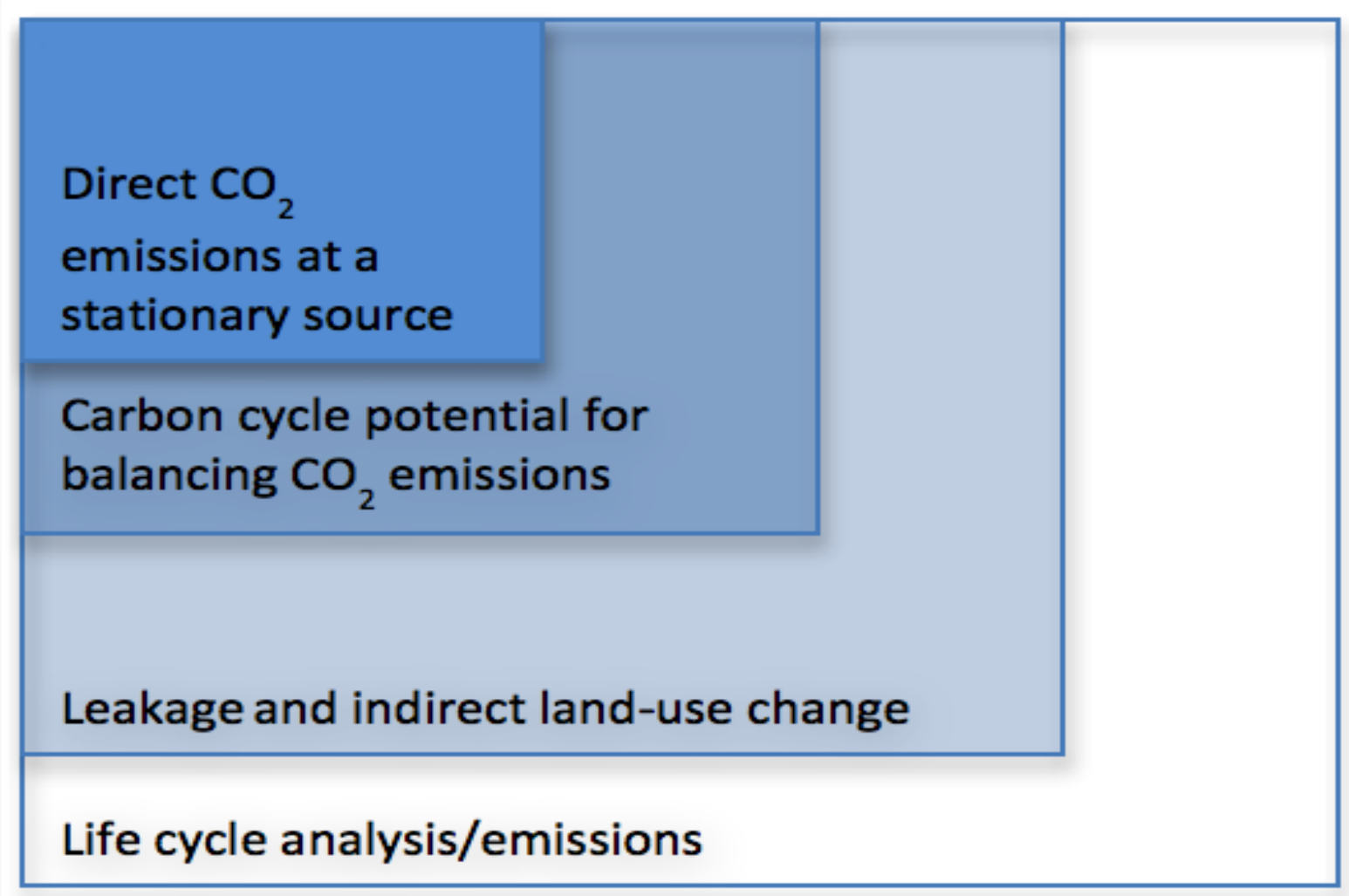
- To conduct a "*detailed examination of the science associated with biogenic CO_2 emissions and to consider the technical issues that the Agency must resolve in order to account for biogenic CO_2 emissions in ways that are scientifically sound and also manageable in practice.*" (Letter from EPA Administrator to Members of Congress, January 12, 2011)

- To answer the question:
  - How can EPA account for a stationary source's onsite CO_2 emissions, taking the biological cycling of carbon into consideration, in a scientifically and technically rigorous manner?

Policy Context

- Consistent with existing stationary source regulatory programs:
  - Direct emissions from stationary source as starting point
  - Fossil and biogenic fuels analyzed comparably
- Critical link from direct emissions to land supplying feedstocks
- Framework generally applicable to all stationary sources:
  - Not specific to any policy or program
  - Flexible enough to be adapted within various types of programs

Defining the Scope



Existing Accounting Approaches

- Use IPCC Approach/U.S. Inventory
  - IPCC Approach requires complete coverage of all sources and sinks
  - Inventory results are presented at national scale
- Categorical exclusion
  - Based on assumption that because biogenic feedstocks grow, biogenic CO_2 *never* contributes to atmospheric load
  - No assessment of carbon stocks or link to the land
- Categorical inclusion
  - Biogenic CO_2 and fossil CO_2 emissions at the stationary source treated as equivalent
  - No assessment of carbon stocks or link to the land
- Lifecycle emissions analysis
  - Comprehensive way to assess net GHG emissions from use of biogenic fuel versus fossil fuels

The Need for a New Accounting Framework

A new accounting framework is needed to adjust biogenic CO_2 emissions from stationary sources

A unique framework is needed that:

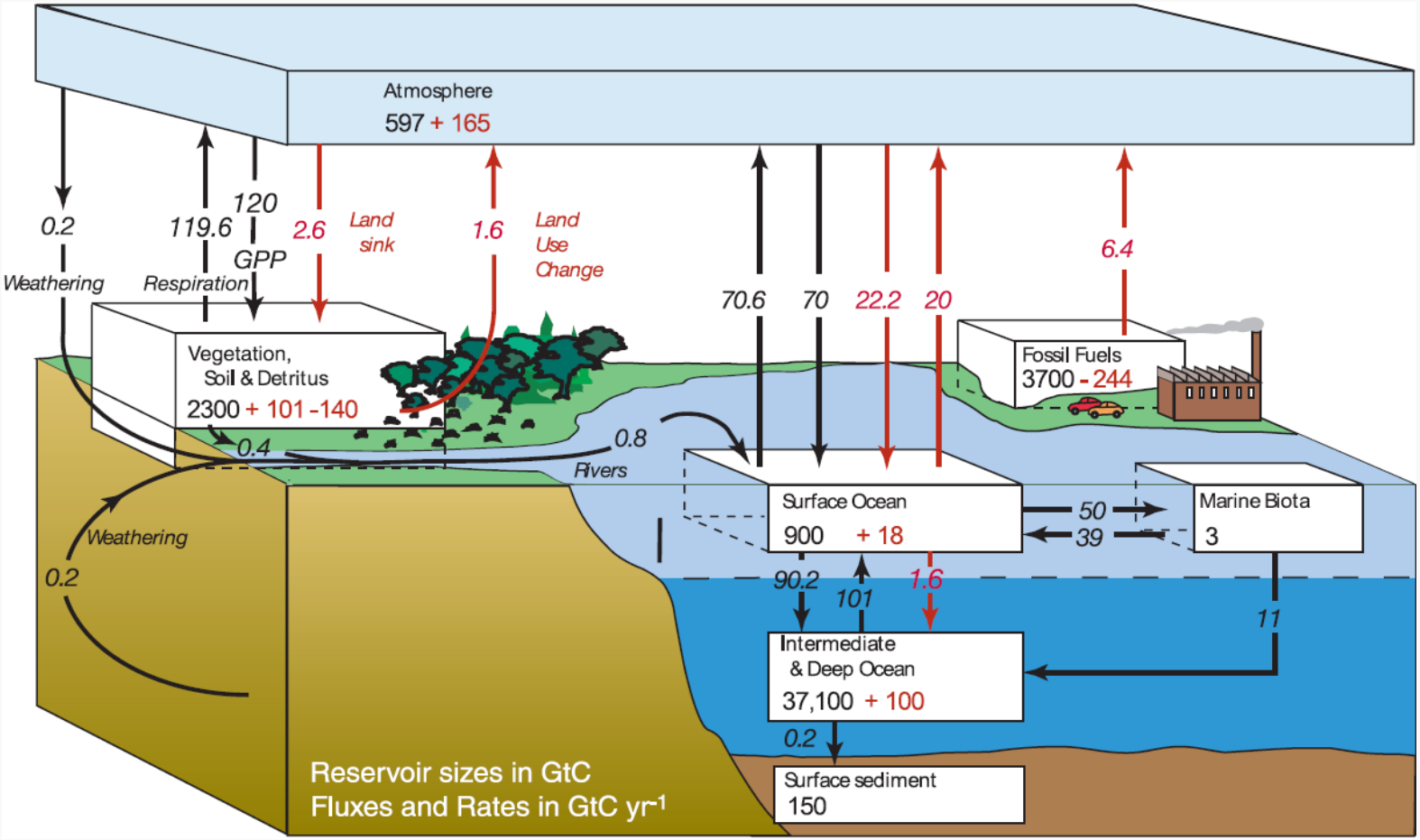
- Accounts for a stationary source's onsite CO_2 emissions, taking the biological cycling of carbon into consideration, in a scientifically and technically rigorous manner
- Creates an "adjustment factor" that can be applied to direct emissions (Biogenic Accounting Factor (BAF))
  - Multiplying direct biogenic CO_2 emissions by the BAF yields the adjusted emissions of biogenic CO_2 to the atmosphere
  - Accounted CO_2 Emissions = Facility CO_2 Emissions * BAF

Specified Criteria

Meets specific criteria:

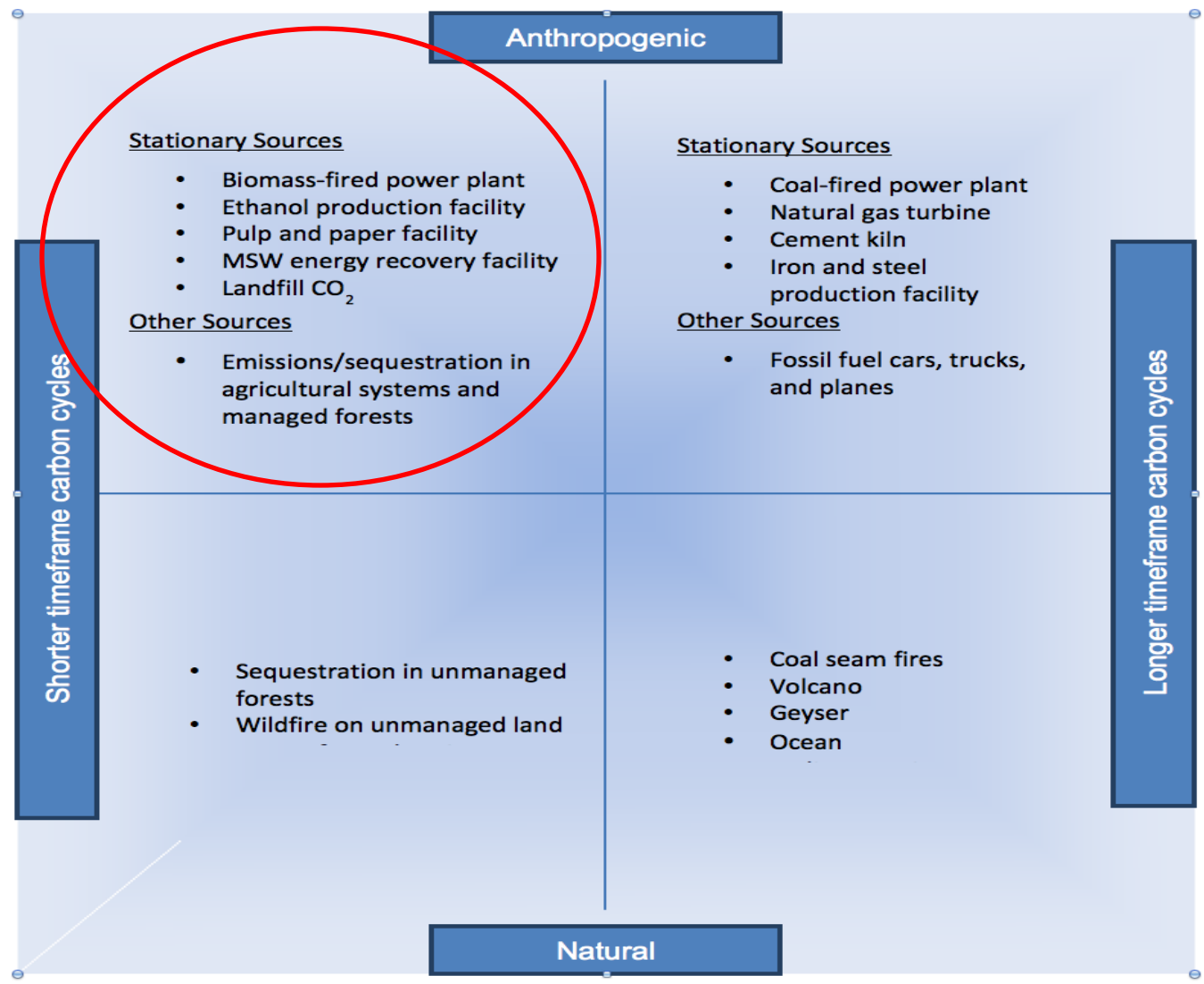
- Accurately reflects the carbon outcome.
- Is scientifically rigorous/defensible.
- Is simple and easy to understand.
- Is simple and easy to implement.
- Is easily updated with new data.
- Uses existing data sources.

Characterization of Carbon Pools and Fluxes



From IPCC, 2007. Climate Change 2007: Mitigation of Climate Change. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change.

Fluxes covered by Accounting Framework



Technical Considerations

Key technical considerations necessary for developing any accounting framework for biogenic CO_2 at stationary sources:

- Direct Emissions
- Feedstock Losses During Transportation and Storage
- Carbon Contained in Products and Byproducts
- Feedstock Growth: Emissions and Sequestration on Land
- Direct Land Use and Management Changes
- Indirect Land Use Change and Leakage
- Temporal Scale
- Spatial Scale
- Baselines
- Biogenic Feedstock Categorization and Disaggregation

Technical Considerations

TECHNICAL CONSIDERATION	DESCRIPTION
Direct Emissions	*Direct emissions of GHG (e.g., CO_2, CH_4, N_2O) that result from use of biologically based feedstock at a stationary source.*
Feedstock Losses During Transportation and Storage	*Potential difference in carbon content when feedstocks are measured at the production site versus at the stationary source.*
Carbon Contained in Products and Byproducts	*A portion of the biogenic feedstock arriving at the gate may be transformed into products, or fuels that contain carbon and exit the stationary source other than out the stack.*
Feedstock Growth/ Avoided Emissions	*Emissions and sequestration on the land (all five terrestrial carbon pools) supplying the biologically based feedstocks.*
Direct Land Use & Management Change	*Emissions/sequestration related to direct land-use change may occur when land use or management are changed to produce a biologically based feedstock.*

Technical Considerations

TECHNICAL CONSIDERATION		DESCRIPTION
Indirect Land Use Change and Leakage		*Demand for biologically-based feedstocks can induce production alterations elsewhere, influencing market prices and including possible land-use change and related emissions/sequestration.*
Temporal Scale	*Annual, Multi-Year*	*Basic timescale for assessing emissions to the atmosphere and changes in carbon stocks on land.*
Spatial Scale	*International, National, Regional, Local*	*Spatial scale, land-base and boundaries over which emissions and sequestration are assessed.*
Baseline	*Reference Point, Anticipated Future, Comparative*	*Datum against which change is measured.*
Feedstock Categorization and Disaggregation	*Forest-Derived, Agricultural, Waste Materials, Other*	*Groupings of types of biologically-based feedstocks based on similarities in characteristics such as physical properties, typical end uses, and growth patterns.*

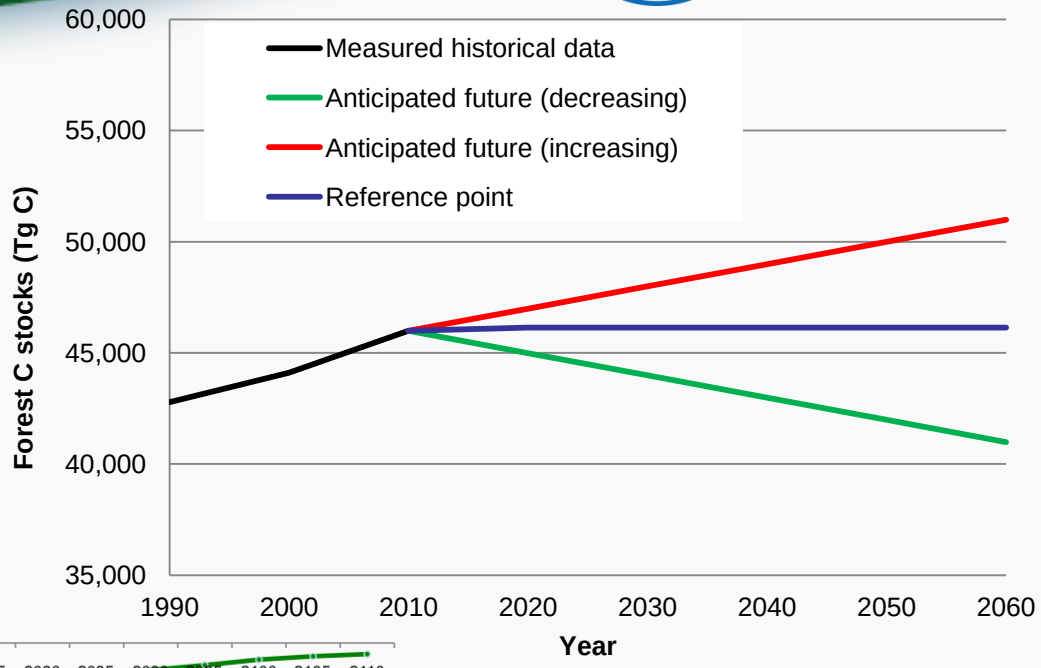
Baselines

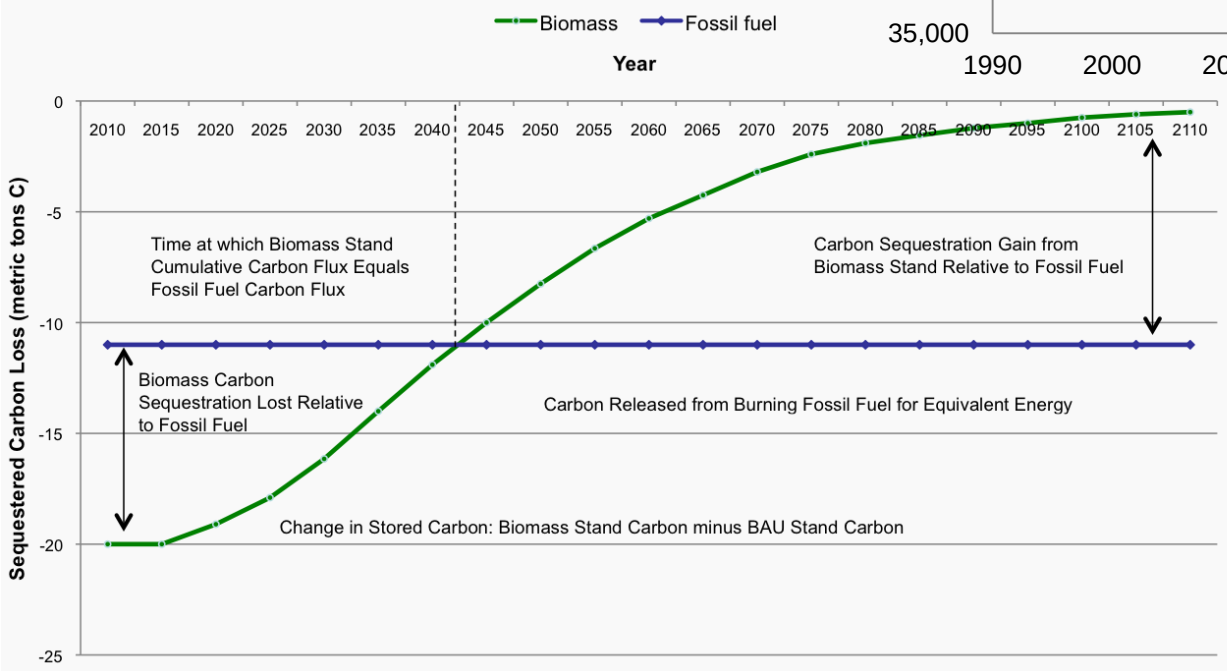
Baselines have been defined in at least three ways, focusing on:

1. The net change from a current reference point
   - **Reference point** baseline
2. The net change from a business-as-usual future
   - **Anticipated future** baseline
3. The net change from an alternative future
   - **Comparative** baseline
   - Includes consideration of alternative energy futures

Baseline Comparison

Reference point and Anticipated future baselines





Comparative baseline

(adapted from Exhibit 6-2b, *Manomet Center for Conservation Sciences, 2010)*

Biogenic Feedstock Categorization and Disaggregation

- Feedstocks may be grouped according to:
  - Physical properties
  - Management and harvest characteristics
  - What would have happened anyway
    - Wastes / residues from other processes
    - Salvage following extreme events such as hurricanes or insect outbreaks
- Three broad categories largely capture all of the biologically based feedstock types that might be used in a stationary source:

1. Forest-Derived Woody Biomass
2. Agricultural Biomass
3. Waste Materials

Accounting Framework: General Description

TECHNICAL CONSIDERATION	STATUS IN EPA FRAMEWORK
Direct Emissions	***CO_2 from use of biologically based feedstocks***
Feedstock Losses During Transportation and Storage	***Included***
Carbon Contained in Products and Byproducts	***Included***
Feedstock Growth/Avoided Emissions	***Included***
Direct Land Use & Management Change	***Included***

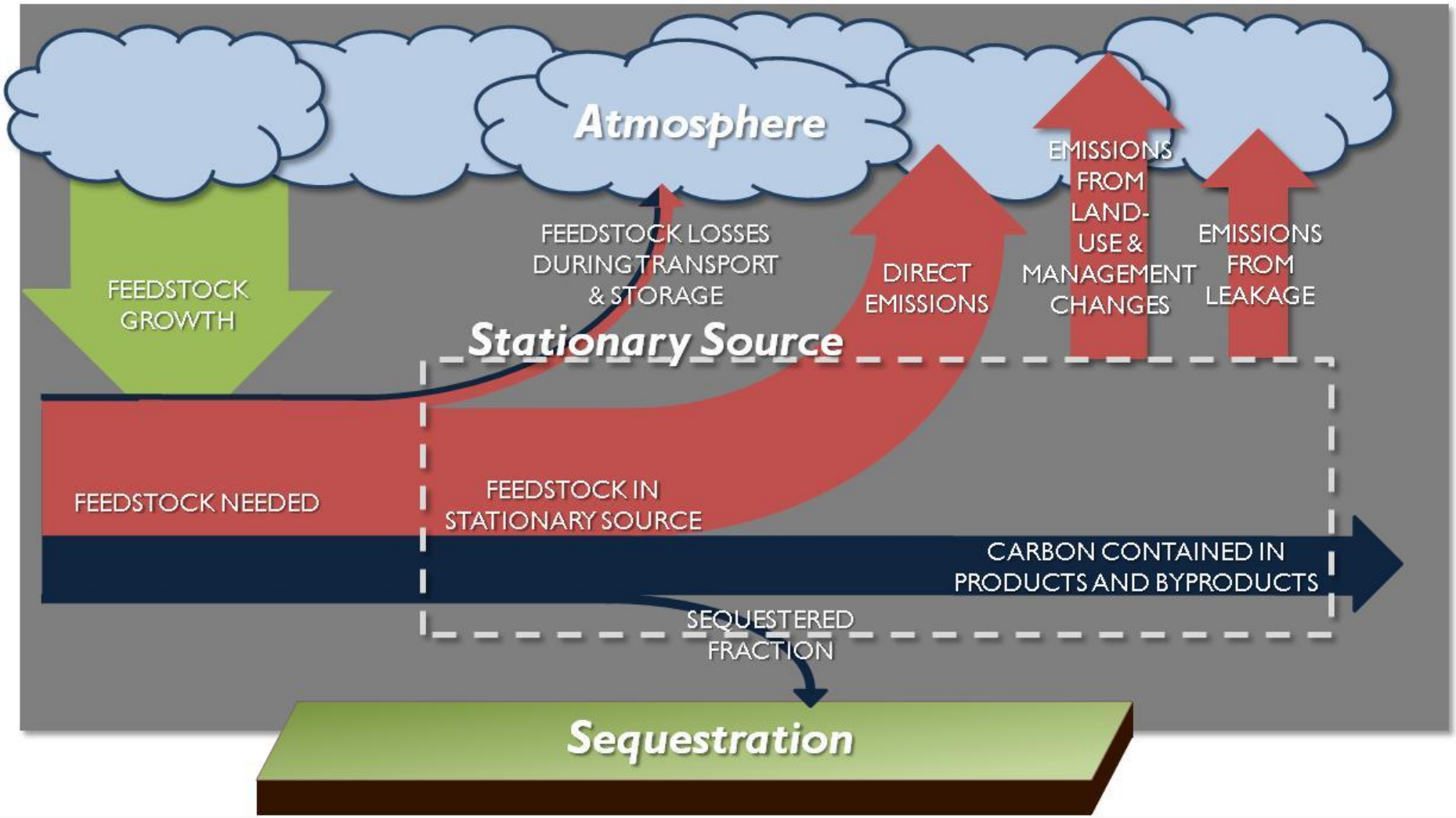
Accounting Framework: General Description

TECHNICAL CONSIDERATION	STATUS IN EPA FRAMEWORK
Indirect Land Use Change & Leakage	***Acknowledged***
Temporal Scale	***Annual, Multi-year***
Spatial Scale	***Regional***
Baselines	***Reference Point***
Feedstock Categorization & Disaggregation	***Forest-Derived, Agricultural, Waste Materials***

Decisions for Implementation

- Equity among facilities
  - Marginal versus average accounting
- Further feedstock categorization and definition
- Exogenous effects on land-based carbon stocks
  - Urbanization, natural disturbance
- Specific regional boundaries
- Treatment of imports and exports

Accounting Framework

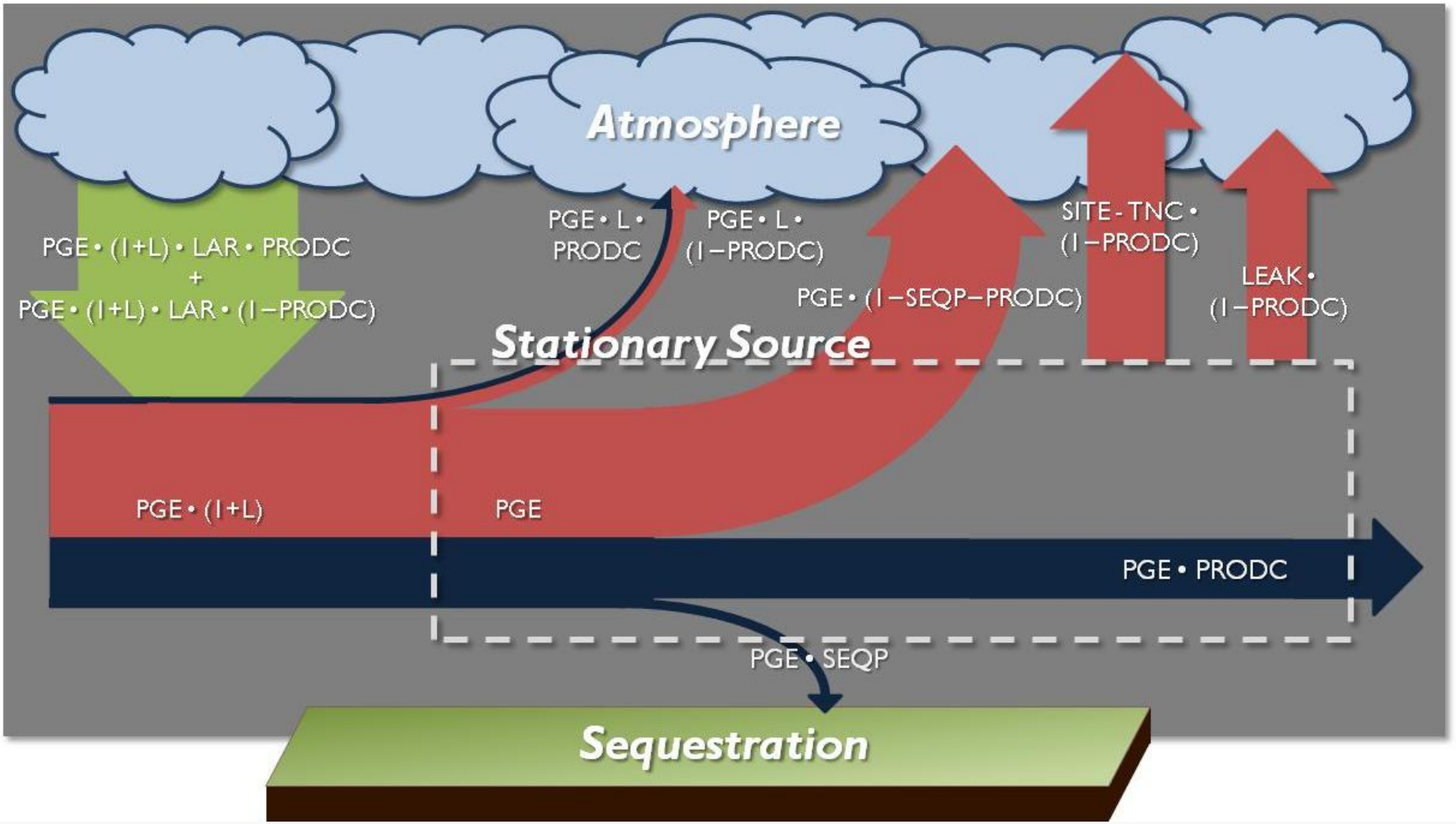


Framework Equation
Breaking it down

$$NBE = [PGE \times (1 + L) \times (1 - LAR) \times (1 - PRODC)] - [PGE \times SEQP] + [SITE\_TNC \times (1 - PRODC)] + [LEAK \times (1 - PRODC)]$$

- ***Stage 1:*** Start with stack emissions ***[PGE]***
- ***Stage 2:*** Add emissions (carbon losses) caused by transferring feedstock to stationary source for use (***[L]***
- ***Stage 3:*** Subtract carbon stored in feedstock regrowth and in other carbon pools on the land providing the feedstock ***[LAR]***
- ***Stage 4:*** **Subtract carbon sequestered in post-combustion materials** ***[SEQP]***
- ***Stage 5:*** Add any changes from direct land-use or management change on the production landscape ***[SITE_TNC]***
- ***Stage 6:*** Add any emissions associated with leakage or indirect land-use change ***[LEAK]***
- ***Throughout:*** Adjust terms for share of carbon in products ***[PRODC]***

Accounting Framework with Terms



Biogenic Accounting Factor

BAF = Net Biogenic Emissions/Potential Gross Emissions

BAF of:	Means:
0	Biogenic processes do not offset the direct biogenic CO_2 emissions from a stationary source
1	100% of the biogenic CO_2 emissions are counted; in other words, biogenic processes offset none of the direct biogenic CO_2 emissions
0 - 1	Some proportion of the biogenic CO_2 emissions are offset by sequestration. *- For example, a BAF of .2 or .5, biogenic processes offset 80% or 50% of the biogenic CO_2 emissions*
Less than 0	Biogenic processes sequester more than the total of biogenic CO_2 emissions. *- For example, a BAF of -0.2 means biogenic processes sequester 20% more than total biogenic CO_2 emissions*

Adjustment:

Accounted Emissions = Facility Biogenic CO_2 Emissions × BAF

Summary

- EPA has developed a new accounting approach for biogenic CO_2 emissions from stationary sources that addresses limitations in existing approaches
- The approach develops a biogenic accounting factor (BAF) that adjusts onsite CO_2 emissions on the basis of information about growth of the feedstock and/or avoidance of biogenic emissions and more generally the carbon cycle
- The BAF approach is generally applicable to a variety of stationary source programs
  - Each application will require explicit program-specific policy choices
  - Any application of the BAF approach in a regulatory context would require a full public notice and comment rule-making process

Thank you

Questions?

SAB Charge Questions

1. *Evaluation of the science of biogenic CO_2 emissions*
2. *Evaluation of the biogenic CO_2 accounting approaches*
3. *Evaluation of methodological issues*
4. *Evaluation of accounting framework*
5. *Evaluation of and recommendations on case studies*
6. *Overall evaluation*