



Forest Service  
U.S. DEPARTMENT OF AGRICULTURE

# Integration of FIA Volume, Biomass, and Carbon Calculation Methods into FVS

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**Overview**

**Anticipated outputs**

**Tentative timeline**

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# FIA Volume, Biomass, and Carbon (FIAVBC)

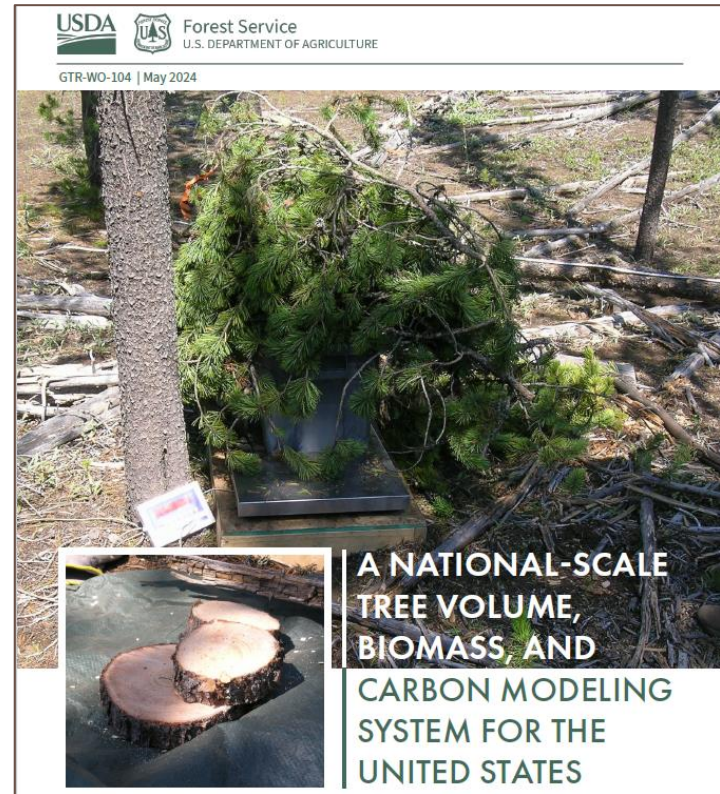
National Scale Volume and Biomass Estimators (NSVB) for timber species

Regional equations used by FIA for woodland species

Enable FIA cubic foot volume, biomass, and carbon calculations in FVS

Align calculation procedures as close as possible to those described in available FIA documentation

- Cull / broken tops
- Decay code
- Revised carbon fractions

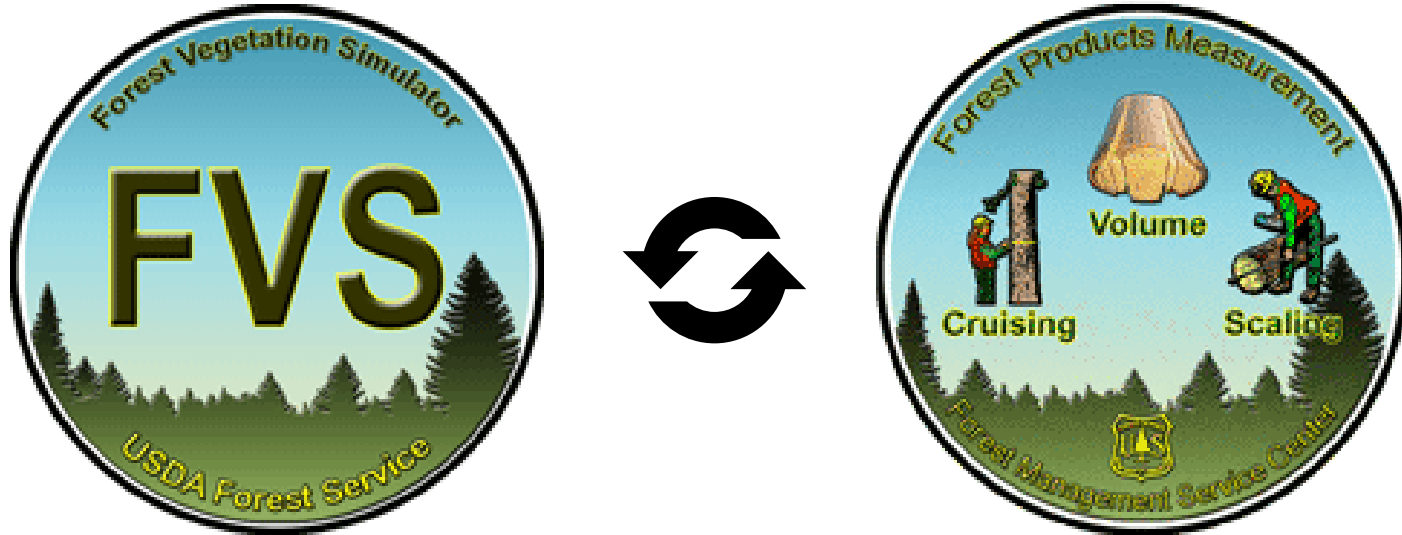


Westfall et al. 2024

# FIAVBC in FVS

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National Volume Estimator Library (NVEL) will be used as the engine for calculating FIA volume, biomass, and carbon estimates



# FIAVBC Inputs

## Stand Level (FVS\_StandInit/PlotInit)

- **ECOREGION:** used to build NVEL equation strings (NSVB)
- **STATE :** State code used to build NVEL equation strings for woodland species.
- **STDORGCD:** Indicator to determine if stand is natural (0) or plantation (1).

STAND_CN	STAND_ID	VARIANT	ECOREGION	STDORGCD	STATE
158852021010854	1372253900131	SN	232Bi	0	13
158847382010854	1372025900281	SN	232Ca		13
158848478010854	1372071900621	SN	232Jf		13
158850851010854	1372185900061	SN	232Jf	0	13
158852973010854	1372299900741	SN	232Cc	0	13
158847392010854	1372025900421	SN	232Ca	0	13
158849107010854	1372103900231	SN	232Ca		13

CULL	DECAYCD	WDLND_STEMS	HISTORY	SPECIES	DIAMETER
40			1	356	7.9
0			1	832	11
1			1	832	14.4
1			1	832	13.3
1			1	316	12.2
0			1	832	5.1
			1	129	1.2
50	3		6	832	5.5
0			1	711	9.2
0			1	316	7.6
0			1	832	6.5
68			1	711	7.1
1			1	832	13.4
99	2		8	129	5.4
0			1	806	17.8

## Tree level (FVS\_Treelnit)

- **WDLND\_STEMS:** Woodland stem count.
- **CULL:** Rotten or missing cull.
- **DECAYCD:** Decay class code. Impacts biomass and carbon for dead trees.

# FIAVBC Keyword

Stands	Time	Components	Select Outputs	*Run*
Management	Modifiers	Event Monitor	Economic	Keywords

Note: Avoid direct use of keywords when possible.

**Extensions**

Base FVS system

**Keywords**

FIAVBC: Activates FIA volume computation

**Component title**

**Activates FIA standard computation methods**

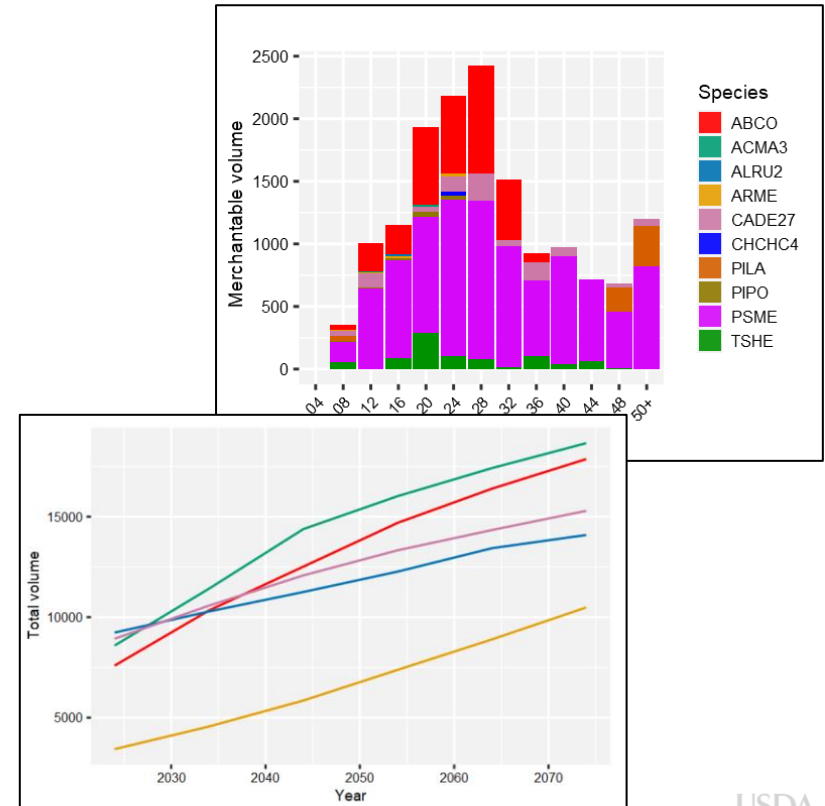
1. Sets FIA merchantable specifications and defines appropriate NVEL equation strings (all species in variant)
2. Has FVS report FIA volume in existing output tables
3. Allows user to produce new FIAVBC output tables

# Anticipated Volume Outputs

Report total stem, merchantable stem, and sawlog cubic volumes in:

- FVS\_Summary/2 and CmpSummary/2
- FVS TreeList/CutList/AtrtList, StdStk, and CmpStdStk
- Predefined event monitor variables and SPMADBH function
- Relevant volumes will also appear in other existing output tables (FFE, ECON, etc.)

Byproduct of update is that base \_East tables will be deprecated



# Biomass and Carbon in FVS

## The Fire and Fuels Extension to the Forest Vegetation Simulator: Updated Model Documentation

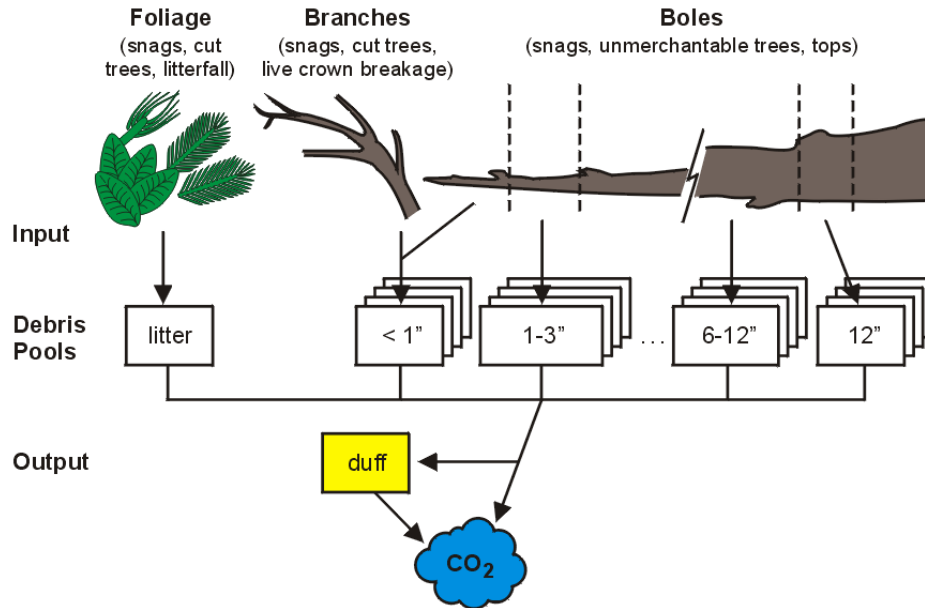
Stand Carbon Report Label <sup>1</sup>	Requested Reporting Method <sup>2</sup>		Calculation Method	
	FFE	Jenkins	FFE All Fuels Report <sup>3</sup>	Jenkins
Aboveground Live, Total	✓	✓	Live, Fol Live, 0-3in <sup>4</sup> Live >3"	f(sp,dbh)
Aboveground Live, Merchantable	✓	✓	Portions of Live >3"	f(sp,dbh)
Stand Dead	✓	FFE method always used	Standing Dead, 0-3in Standing Dead, >3"	
Forest, Shb/Hrb	✓		Herb Shrub	
Forest, Floor	✓		Litter Duff	
Forest, DDW	✓		Dead Surface Fuel 0-3in Dead Surface Fuel >3in	
Belowground, Live	Jenkins method always used	✓		f(sp,dbh)
Belowground, Dead		✓		f(sp,dbh)

How does FVS currently produce biomass and carbon?

- All biomass and carbon estimation in FVS occurs within FFE
- By default, biomass of fuel loadings is converted into carbon estimates
- User has the option to replace some carbon pools with estimates from Jenkins 2003 equations (CARBCALC)
- Do FIAVBC methods and FFE play nicely together...

# Complications Implementing FIAVBC in FFE

...Not at the moment



- FFE calculations of biomass/carbon by size class do not allow FIA calculation procedures to be readily maintained
- Challenging to comprehensively account for attributes such as broken tops, cull, decay code, and revised carbon fractions
- FFE codebase would need significant update to balance objectives of fire and fuel modeling with biomass/carbon reporting consistent with FIA-VBC

# Anticipated Biomass and Carbon Outputs

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FIA carbon and biomass calculations seem better suited for base FVS

Biomass and carbon attributes that will be reported

- Aboveground (stem wood + branch + bark)
- Merchantable stem (wood)
- Sawlog portion of stem (wood)
- Foliage

Belowground biomass/carbon will **not be** included since calculation method is not currently available in NVEL

FVS\_FIAVBC\_Summary  
(Stand level)

FVS\_FIAVBC\_  
Treelist / Cutlist / Attrlist  
(Tree level)

Event Monitor  
(Predefined stand  
variables)

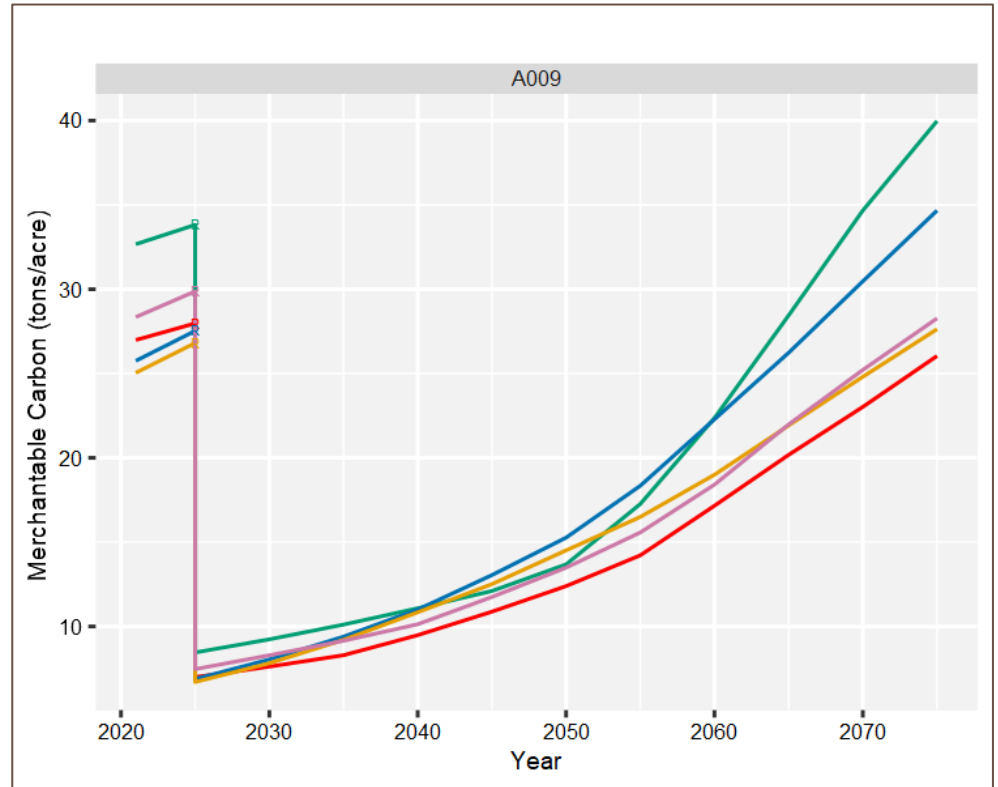
# FIAVBC Stand Level Output

FVS\_FIAVBC\_Summary will look like the FVS\_Summary2 table

FIA volume, biomass, and carbon will be reported for the following conditions:

- Before thinning
- After thinning
- Removals

Attributes will also be available as pre-defined stand variables (FVS\_Compute and CmpCompute tables)



# FIAVBC Tree Level Output

**Stand/Plot identification:** StandID, PlotID, ActPt

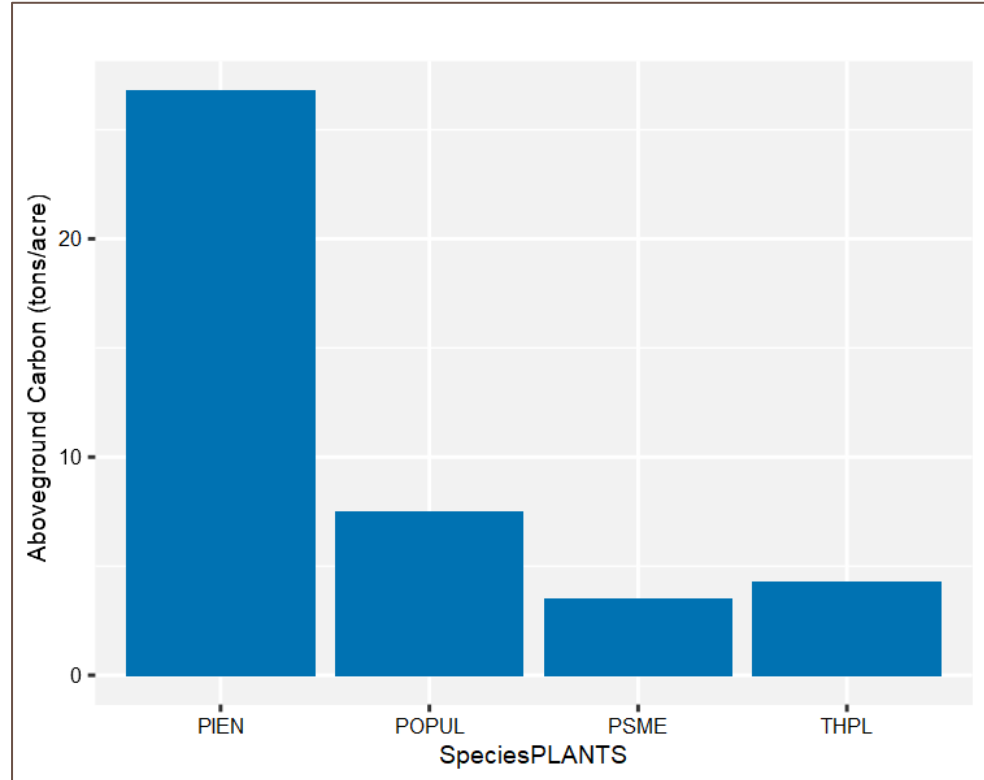
**TreelD/Species:** TreelD, TreeIndex, species codes

**Tree size:** DBH, heights, crown ratio

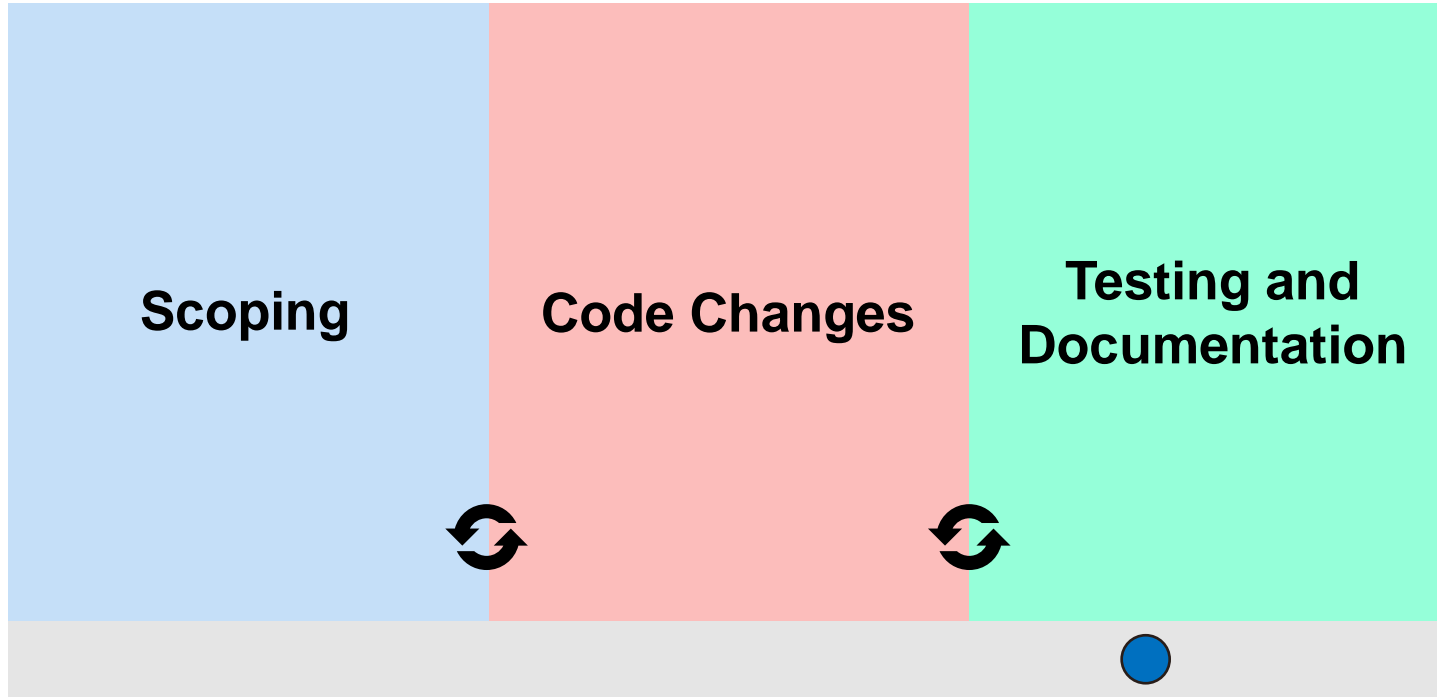
**FIA attributes:** Cull, decay code, carbon fraction

**Volume:** Total, merchantable, sawlog

**Biomass/carbon:** Aboveground, foliage, merchantable, sawlog



# Timeline



**Project  
Completion**

10/1/2025

# Questions or Comments?

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Thanks for Listening!



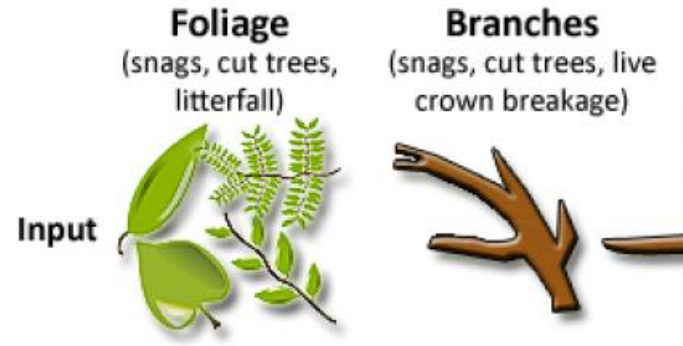
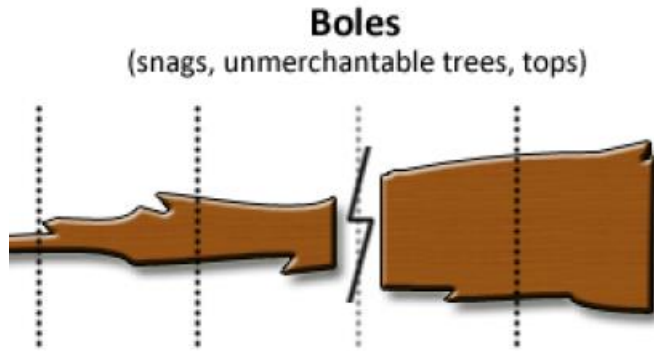
Contact:  
[mark.castle@usda.gov](mailto:mark.castle@usda.gov)

# What Happens in FFE When FIAVBC is Invoked?

All biomass and carbon in FFE will be calculated using existing FFE Algorithms...

FIA gross cubic stem volume converted  
to biomass/carbon (no bark)

Existing FFE Equations



FFE algorithms do not align with FIA calculation procedures for standing biomass and carbon