



# AIP-Enviva Biomass: The Optimal Fiber Mix Tool

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— SUMMER 2025 —

# Our project's impact & Enviva's scale create large revenue opportunities

**Enviva's Yearly Revenue:**  
\$XX Billion

**Revenue Generation:**  
\$XX - \$XX Million / year

**Capacity Model Predictive Accuracy:**  
XX% Increase



# Opportunity to optimize fiber mix reduces bottlenecks and boosts profitability

## Fiber Mix (Input to the Process)

- 16 commodities
- XX million tons procured
- 50% of cost of goods sold in 2024
- Fiber mix directly impacts variables that lead to bottlenecks
- No standard procedure/methodology in selection



# Project Scope included three major components

## Fiber Mix Model

### Moisture Content (MC) Assumption Validation

- Compared historical mix MC values with the model prediction with the corresponding historical mix percentages
- Updated the MC assumptions to improve model accuracy

### Particle Size Distribution (PSD) Assumption Creation and Validation

- Created ¼" PSD assumptions
- Validated and implement PSD calculations into the Optimal Fiber Mix Tool

### Transpiration Dried Wood (T-Wood) Model

- Created model to predict the drop in MC as roundwood ages
- Implemented T-wood commodities (with MC assumptions) into the Optimal Fiber Mix Tool

### Process Capacity Model

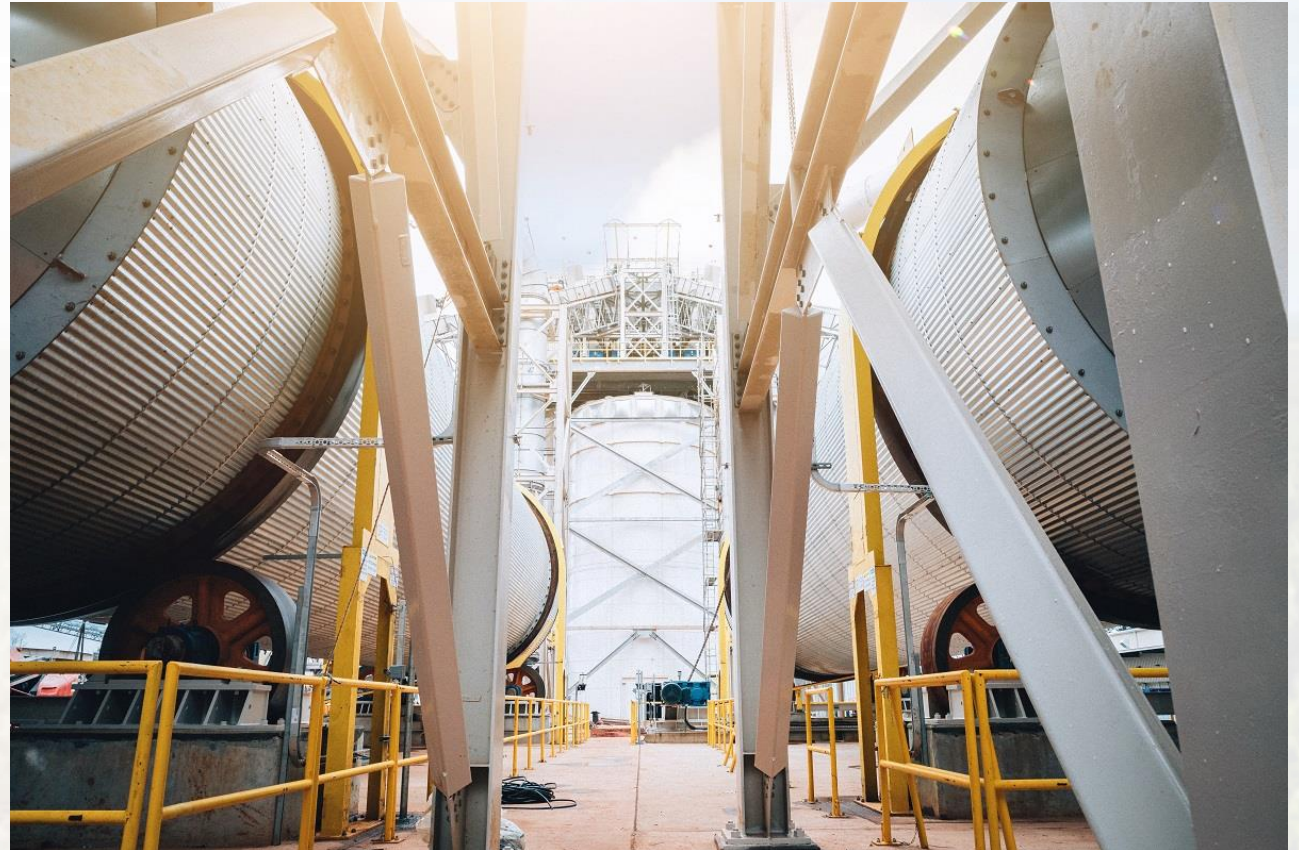
- Implementation of PSD into capacity outputs



# Moisture Content (MC)

# Wood drying is the most common bottleneck in the production process

- Wood Mix ~ 45% Water
- Final Pellet ~7% Water
- Affects revenue seasonally
- Major bottleneck 6/9 sites



# True and Model MCs allow us to validate and update assumptions

## Ways to obtain Mix MC

Commodity MC Assumptions  
& Daily Fiber Mix



Weighted Average



"Model" MC

Directly Measured



Lab Tests



"True" MC

# Initial State of commodity MC assumptions use incomplete data

Commodity	Moisture Content Assumption
HW CEM	42%
Pine CEM	48%
Hardwood micro	44%
Hardwood chips	42%
Hardwood dust	43%
Hardwood Trim Ends	18%
Hardwood Pole Peelings	40%
Hardwood Sawmill Chips	44%
Pine micro	51%
Pine chips	49%
Pine dust	51%
Pine Trim Ends	18%
Pine Pole Peelings	40%
Pine Sawmill Chips	44%
Dry material	13%
FD / Pellets / Other	13%

## Issues

- Seasonality not captured
- Missing some sites data

MC

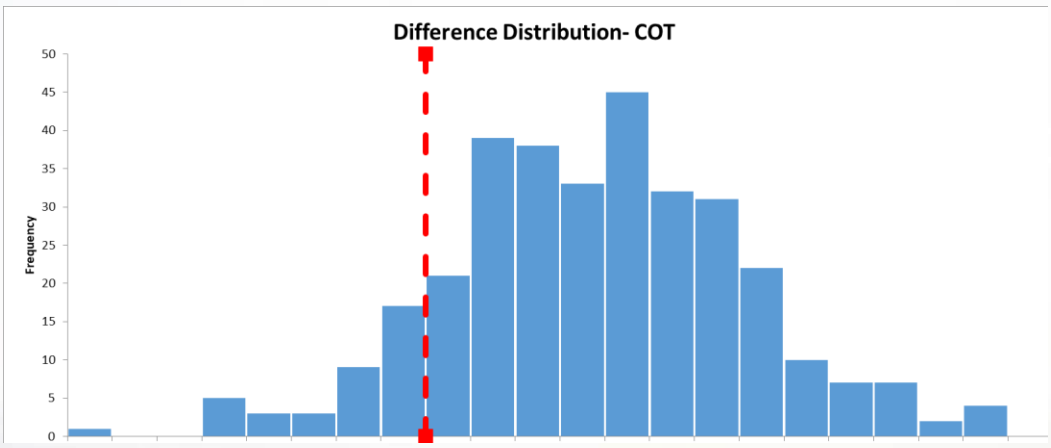
PSD

Capacity

T-Wood

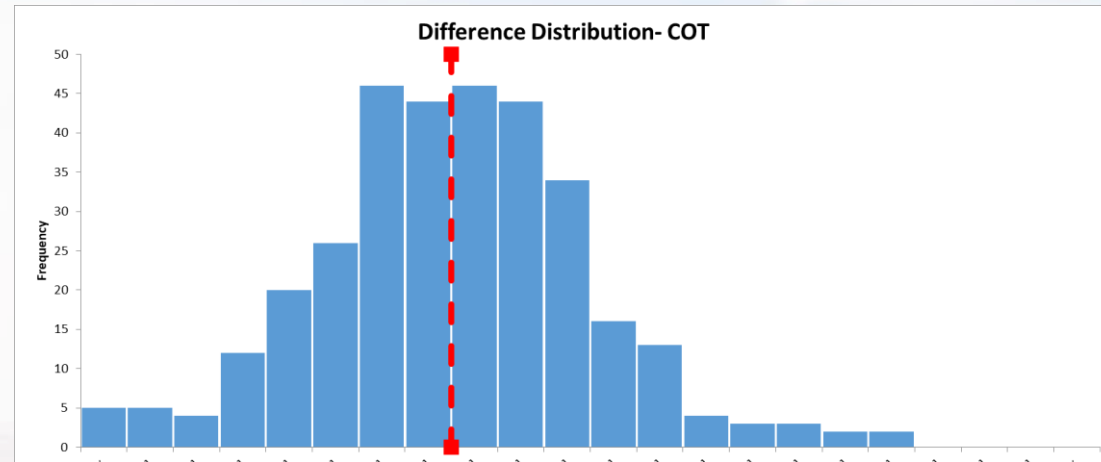
# Optimized MC assumptions reduced gap between modeled mix MC and true MC

## Original



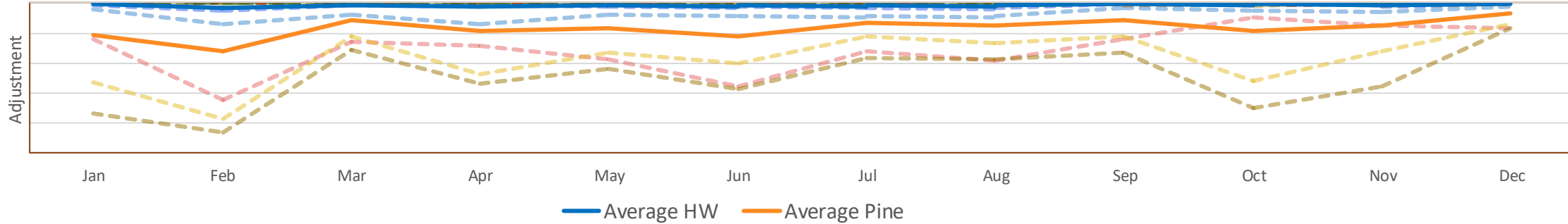
Avg. Difference	XX%
Standard Dev:	XX%

## Current

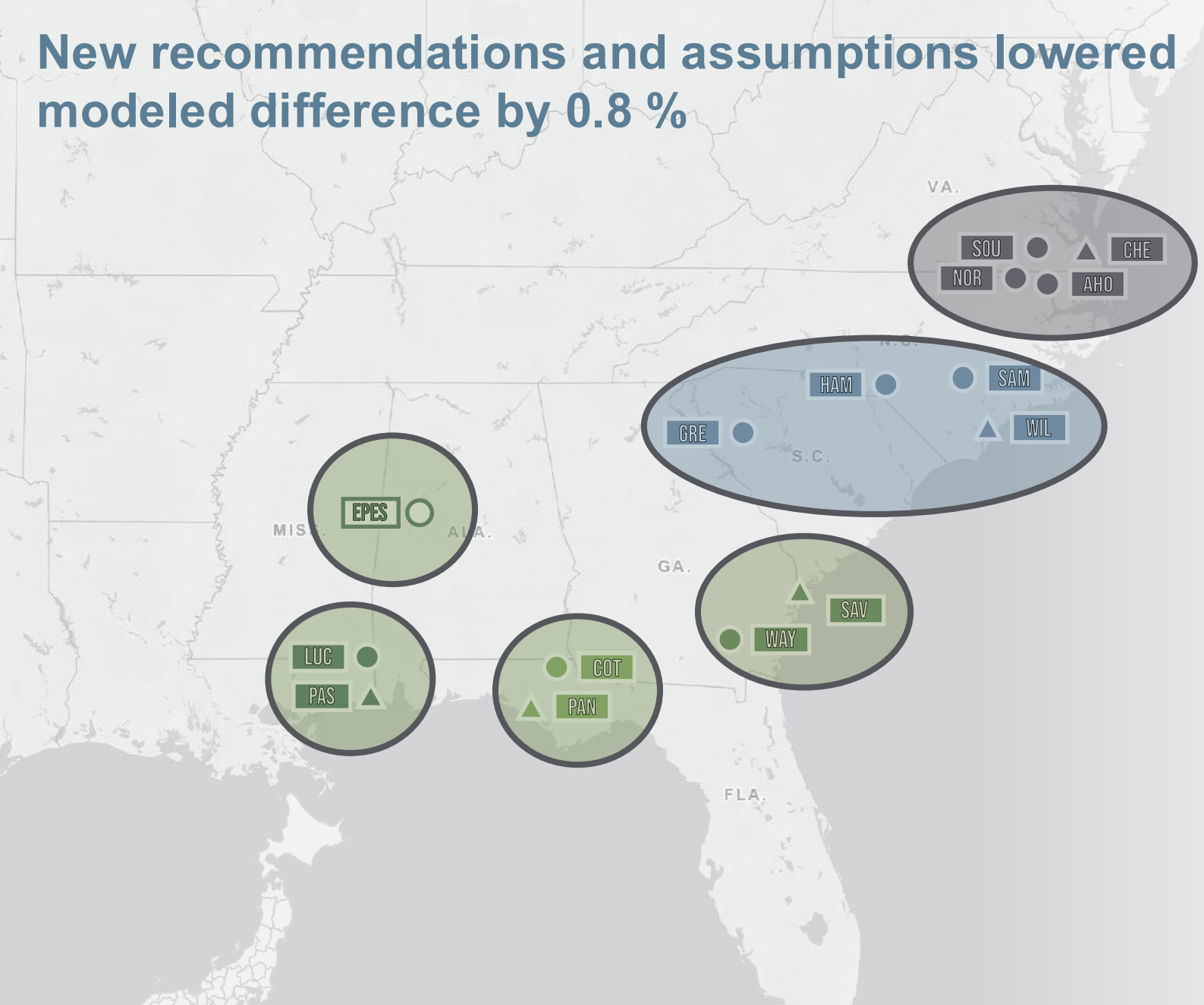


Avg. Difference	XX%
Standard Dev:	XX%

### % Adjustments by commodity



# New recommendations and assumptions lowered modeled difference by 0.8 %



## Recommendations:

- We Recommend Grouping MC Assumptions by Region
- Standardize Fiber Inventory/Mix Tracking and MC data locations

## Impact:

Average Difference  
**XX% → XX%**

Standard Deviation  
**XX% → XX%**

- 6/9 Sites Dryer Bottlenecked
- ± 1% in Mix MC → ~ ± 7% throughput

▲ TERMINALS OWNED OR LEASED  
 ● PLANTS OWNED AND OPERATED



A photograph of a forest with two large, textured tree trunks in the foreground. The background is filled with many thinner, vertical tree trunks, creating a sense of depth. The lighting is bright, suggesting a sunny day. The text 'Particle Size Distribution (PSD)' is overlaid in white, bold font across the center of the image.

# Particle Size Distribution (PSD)

# We created and integrated the first PSD assumptions into the Fiber Mix Model

Manufactured Chips	NOR	SOU	SAM	WAY	COT	GRE
HW	46%	42%	56%	60%	51%	49%
Pine	42%	49%	62%	60%	51%	49%

Other Commodities - Constant across sites	
Hardwood micro	63%
Hardwood chips	30%
Hardwood dust	69%
Hardwood Trim Ends	30%
Hardwood Pole Peelings	30%
Hardwood Sawmill Chips	30%
Pine micro	65%
Pine chips	35%
Pine dust	76%
Pine Trim Ends	30%
Pine Pole Peelings	30%
Pine Sawmill Chips	30%
Dry material	0%
FD / Pellets / Other	75%
Aged Mix Material	30%

## Actions:

Added calculations to get PSD as an output of the Fiber Mix Model

## Impact:

3/9 Sites Sizing Bottlenecked

- Accurate PSD numbers are vital to predicting sizing capacity



# PSD-informed model outperforms the previous capacity model

## Actions:

- Created new Process Capacity Model that incorporates mix PSD

Northampton Site	Annual Tons Produced	% Error
Actual Production	XX	
Process Capacity Model	XX	1.74%
Forecast Model – 95% DU	XX	7.35%
Forecast Model – 90% DU	XX	0.96%

**Notes:** Process Capacity Model uses historical dryer uptime (DU) and MC% values, and the Forecast Model uses dryer uptime assumptions and forecasted MC%





**Transpiration  
Dried Wood  
(T-Wood)**

# Transpiration Dried (T-wood) Wood Commodities were Added to the Existing Commodities

Commodities
HW CEM
Pine CEM
Hardwood micro
Hardwood chips
Hardwood dust
Hardwood Trim Ends
Hardwood Pole Peelings
Hardwood Sawmill Chips
Pine micro
Pine chips
Pine dust
Pine Trim Ends
Pine Pole Peelings
Pine Sawmill Chips
Dry material
FD / Pellets / Other
<b>HW RW T-Wood</b>
<b>Pine RW T-Wood</b>
<b>HW Chips T-Wood</b>
<b>Pine Chips T-Wood</b>

**Original**

**Added**

Natural drying of wood when left out after felling useful for lowering Mix MC

Model requires MC assumptions

**Goal: Create a model to predict the MC of aged wood**



# Theoretical T-Wood model provides the required information for the selection of the Optimal Mix with two main use cases

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y			
1																												
2		<b>INPUT</b>																										
3	Click here to run macro to find T-Wood Commodity MC	Starting MC%	48.62	wet-basis (input)																								
5		Species	IWPine	<-- use drop down																								
6		Site	WAY	<-- use drop down																								
7																												
40		<b>OUTPUT 1</b>																										
41		Wet Basis		Current Month																								
42		Column1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec														
43		T1	48.56	48.28	47.85	47.32	46.90	46.69	46.73	47.02	47.43	47.92	48.36	48.59														
44		T2	48.56	48.14	47.18	46.40	45.57	45.08	45.05	45.48	46.20	47.10	47.98	48.48														
45		T3	48.57	48.11	46.52	45.72	44.38	43.61	43.39	43.87	44.81	46.11	47.43	48.28														
46		T4	48.56	48.17	45.86	45.24	43.40	42.31	41.79	42.20	43.29	44.93	46.69	47.95														
47		T5	48.48	48.28	45.21	44.95	42.67	41.13	40.26	40.53	41.69	43.60	45.76	47.47														
48		T6	48.30	48.41	44.56	44.86	42.12	40.19	38.86	38.89	39.99	42.16	44.61	46.82														
49		T7	47.98	48.51	43.92	44.96	41.82	39.32	37.66	37.32	38.29	40.58	43.32	45.93														
50		T8	47.51	48.55	43.28	45.20	41.71	38.70	36.60	35.87	36.61	38.88	41.91	44.87														
51		T9	46.86	48.48	42.66	45.54	41.78	38.37	35.70	34.48	35.00	37.19	40.33	43.60														
52		T10	46.00	48.28	42.03	45.98	42.03	38.21	35.01	33.30	33.47	35.42	38.70	42.12														
53		T11	44.91	47.89	41.42	46.48	42.48	38.30	34.49	32.22	32.06	33.69	37.01	40.54														
54		T12	43.61	47.32	40.81	46.98	43.05	38.57	34.10	31.43	30.81	32.04	35.15	38.88														
55																												
56		<b>OUTPUT 2</b>																										
57		Wet Basis		Starting Week (Week of Felling)																								
58		Age/Month	1-Jan	8-Jan	15-Jan	22-Jan	29-Jan	5-Feb	12-Feb	19-Feb	26-Feb	5-Mar	12-Mar	19-Mar	26-Mar	2-Apr	9-Apr	16-Apr	23-Apr	30-Apr	7-May	14-May	21-May	28-May	4-Jun			
59		T1	48.60	48.57	48.53	48.47	48.41	48.33	48.24	48.13	48.02	47.92	47.80	47.66	47.55	47.45	47.31	47.18	47.11	47.00	46.94	46.88	46.77	46.73	46.69			
60		T2	48.59	48.53	48.45	48.34	48.22	48.09	47.91	47.71	47.50	47.31	47.08	46.83	46.63	46.43	46.18	45.94	45.80	45.60	45.50	45.38	45.17	45.11	45.03			
61		T3	48.57	48.49	48.37	48.21	48.03	47.84	47.57	47.28	46.99	46.70	46.37	46.01	45.71	45.42	45.07	44.71	44.52	44.22	44.09	43.91	43.61	43.52	43.41			
62		T4	48.56	48.45	48.29	48.08	47.84	47.59	47.24	46.86	46.47	46.10	45.67	45.19	44.81	44.43	43.97	43.50	43.26	42.86	42.70	42.48	42.08	41.96	41.83			
63		T5	48.54	48.41	48.21	47.96	47.66	47.34	46.91	46.44	45.96	45.50	44.97	44.38	43.91	43.45	42.88	42.31	42.01	41.53	41.34	41.07	40.58	40.45	40.28			
64		T6	48.52	48.37	48.13	47.83	47.47	47.10	46.58	46.03	45.45	44.90	44.28	43.58	43.02	42.48	41.81	41.13	40.80	40.23	40.01	39.71	39.13	38.97	38.78			
65		T7	48.51	48.32	48.05	47.70	47.29	46.85	46.26	45.61	44.94	44.31	43.59	42.79	42.15	41.53	40.76	39.98	39.61	38.96	38.72	38.38	37.71	37.54	37.33			
66		T8	48.49	48.28	47.97	47.57	47.10	46.61	45.93	45.20	44.44	43.73	42.91	42.00	41.29	40.59	39.73	38.85	38.44	37.73	37.47	37.09	36.34	36.16	35.93			
67		T9	48.48	48.24	47.89	47.44	46.92	46.36	45.61	44.78	43.94	43.15	42.24	41.23	40.44	39.67	38.71	37.75	37.31	36.52	36.25	35.85	35.02	34.83	34.58			
68		T10	48.46	48.20	47.81	47.31	46.73	46.12	45.28	44.38	43.44	42.57	41.57	40.46	39.60	38.76	37.72	36.67	36.20	35.35	35.07	34.65	33.74	33.55	33.28			
69		T11	48.45	48.16	47.73	47.19	46.55	45.88	44.96	43.97	42.95	42.00	40.91	39.70	38.78	37.88	36.75	35.62	35.13	34.21	33.93	33.49	32.51	32.32	32.03			
70		T12	48.43	48.12	47.65	47.06	46.36	45.64	44.64	43.56	42.46	41.43	40.26	38.96	37.97	37.01	35.80	34.59	34.09	33.12	32.84	32.37	31.33	31.14	30.84			
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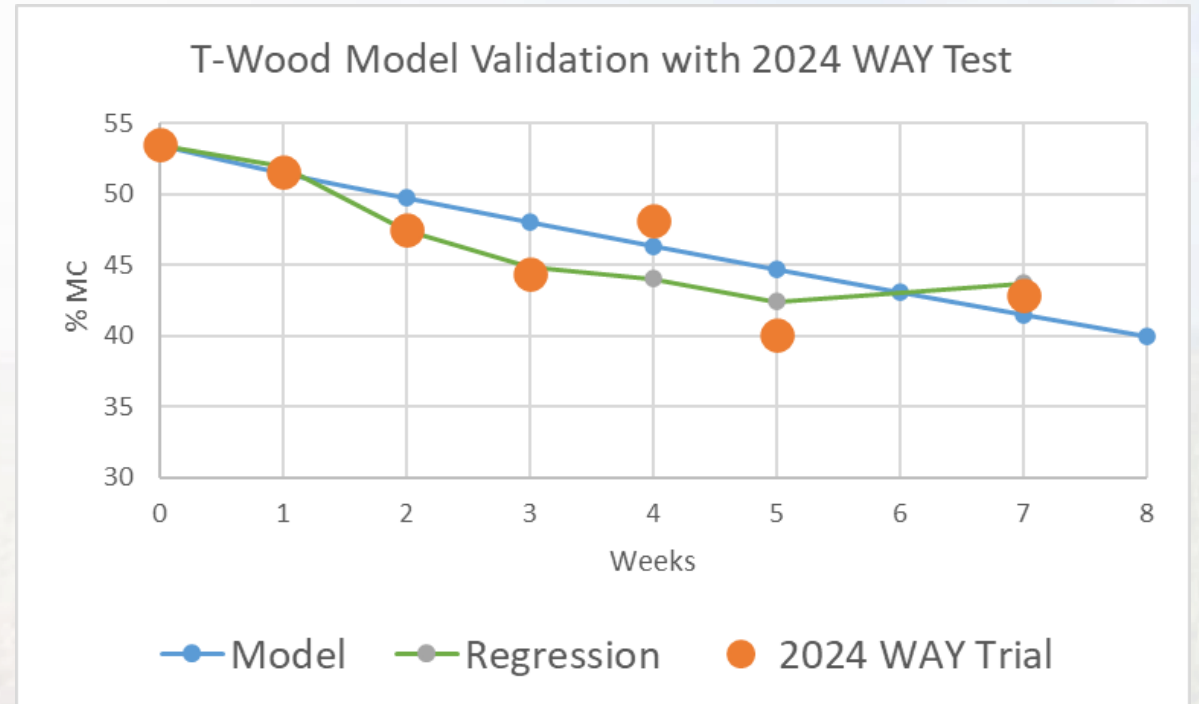
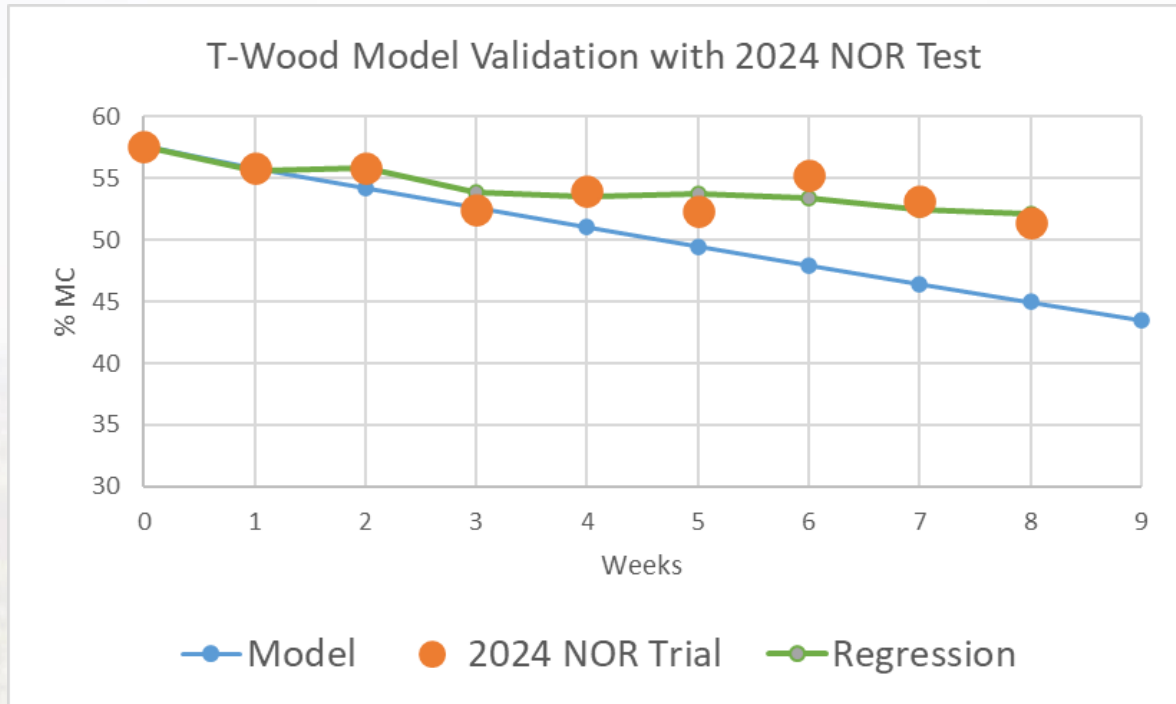
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65		T7	48.51	48.32	48.05	47.70	47.29	46.85	46.26	45.61	44.94	44.31	43.59	42.79	42.15	41.53	40.76	39.98	39.61	38.96	38.72	38.38	37.71	37.54	37.33			
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67		T9	48.48	48.24	47.89	47.44	46.92	46.36	45.61	44.78	43.94	43.15	42.24	41.23	40.44	39.67	38.71	37.75	37.31	36.52	36.25	35.85	35.02	34.83	34.58			
68		T10	48.46	48.20	47.81	47.31	46.73	46.12	45.28	44.38	43.44	42.57	41.57	40.46	39.60	38.76	37.72	36.67	36.20	35.35	35.07	34.65	33.74	33.55	33.28			
69		T11	48.45	48.16	47.73	47.19	46.55	45.88	44.96	43.97	42.95	42.00	40.91	39.70	38.78	37.88	36.75	35.62	35.13	34.21	33.93	33.49	32.51	32.32	32.03			
70		T12	48.43	48.12	47.65	47.06	46.36	45.64	44.64	43.56	42.46	41.43	40.26	38.96	37.97	37.01	35.80	34.59	34.09	33.12	32.84	32.37	31.33	31.14	30.84			
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We are in July, what's the MC of wood that fell 10 weeks Ago?

Today is April 30<sup>th</sup>, What will the MC of the wood we received today be in 10 weeks?



# Future work on T-Wood drying could improve predictions using relevant weather data



**Future Work: Collect T-wood MC data to build regressions (template built)**



# T-wood will increase throughput for dryer bottlenecked months, increasing profit

## Actions:

Model Impacts of an all T-wood – Pine RW Substitution

## Impact:

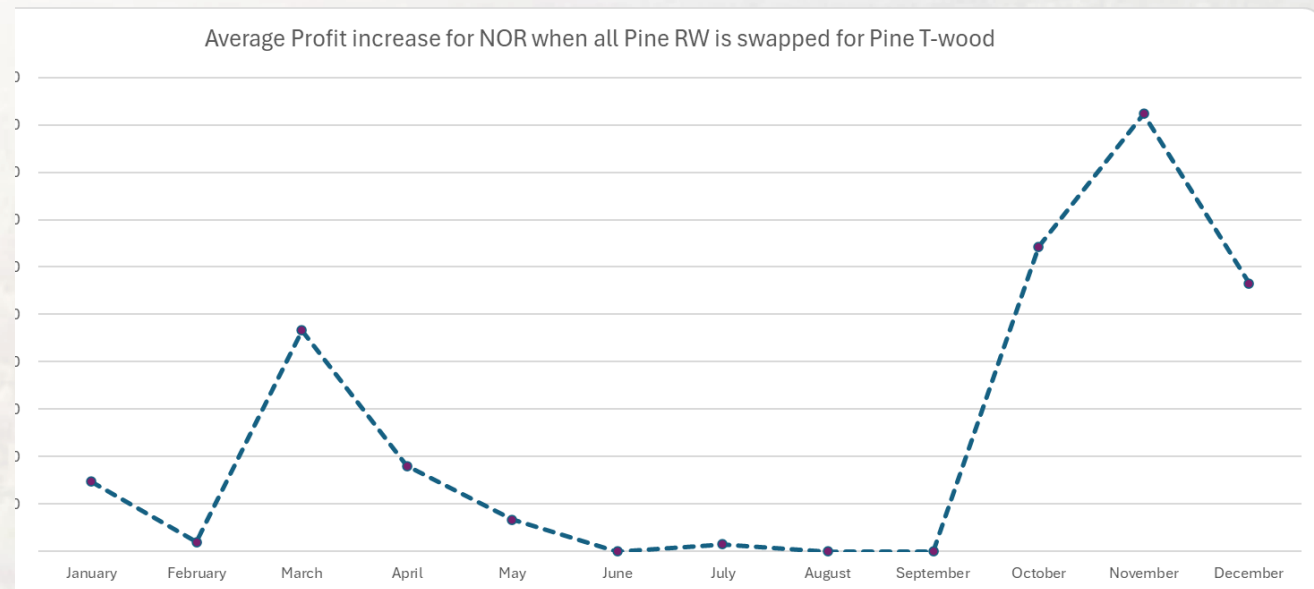
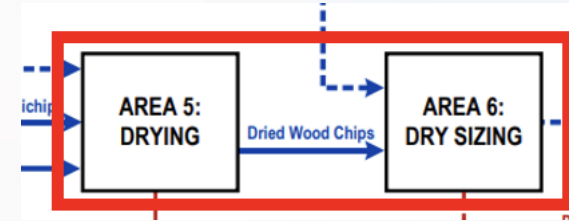
Estimated potential decrease in Mix MC  
**44.96% → (42.92%~43.19%)**

Estimated increase in profit margins  
**\$XX M ~ \$XX M**

Estimated Increase in pellet production  
(Pellet Short Tons/year)  
**XXK – XXK**

Or Increase in production  
(Bone-Dry Short Tons /Hr)  
**(2.8% ~ 3.9% )**

In the Summer Months, drier wood shifts the bottleneck to Dry-Sizing



# Overall Impact

*The Optimal Fiber Mix Tool will provide Enviva with a unified decision-making framework connecting procurement, operations, quality, and finance.*

**Capacity Model  
Predictive Accuracy:**  
5.2% Increase

**Revenue Generation  
from T-Wood:**  
\$XX - \$XX Million / year