



Feedstock Supply Curves for Biojet Facilities in the NARA Region

Greg Latta
University of Idaho

presented at:

2016 Northwest Wood-based Biofuels and Co-products Conference

May 3, 2016

Seattle, Washington

Northwest Advanced Renewables Alliance





Brief Outline

- What is NARA
- What I mean by Forest Sector Model
- Why would NARA need such a model
- Example of Logging Residue Supply Curves
 - Integration of Supply Logistics Group NARA research
 - Integration of larger forest products markets
 - Moving across NARA region (OR, WA, ID& MT)
- Future Direction



What is NARA?

Northwest Advanced Renewables Alliance

Our Mission:

To provide stakeholders, interested in creating a forest residuals to bio-jet industry, with regional solutions that are economically viable, socially acceptable, and meet the high environmental standards of the Pacific Northwest (WA, OR, ID and MT).



FRP

FOREST RESIDUES PREPARATION

Primary feedstock targets include forest residues from logging and thinning operations. We are also considering mill residues and discarded woody material from construction and demolition, in regions where these materials are under utilized.



T

TRANSPORTATION

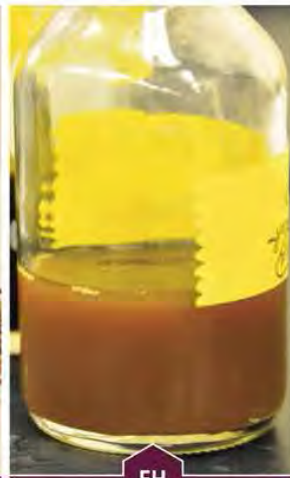
Feedstocks are transported from the collection site to a conversion facility. Chipping can take place at the loading or in a preprocessing facility.



PT

PRE-TREATMENT

Wood chips are treated to make the sugar polymers (polysaccharides) accessible to degrading enzymes. These processes allow the lignin to be available for separation.



EH

ENZYMATIC HYDROLYSIS

Specific enzymes are added to hydrolyze (cleave) the polysaccharides and generate simple sugars (monosaccharides).



F

FERMENTATION

Specialized yeast convert the monosaccharides into isobutanol.



BCP

BIOJET & CO-PRODUCTS

Aviation fuels can be generated from the platform molecules derived from wood sugars. Lignin can be used to generate co-products such as epoxies, structural materials and bio-based plastics. As an alternative, lignin can be burned to produce renewable energy.

1000 kg BONE DRY WOODY BIOMASS

+

DIESEL

+

HEAT, WATER, & CHEMICALS

=

~300 kg LIGNIN

AND

~260 LITERS ISOBUTANOL

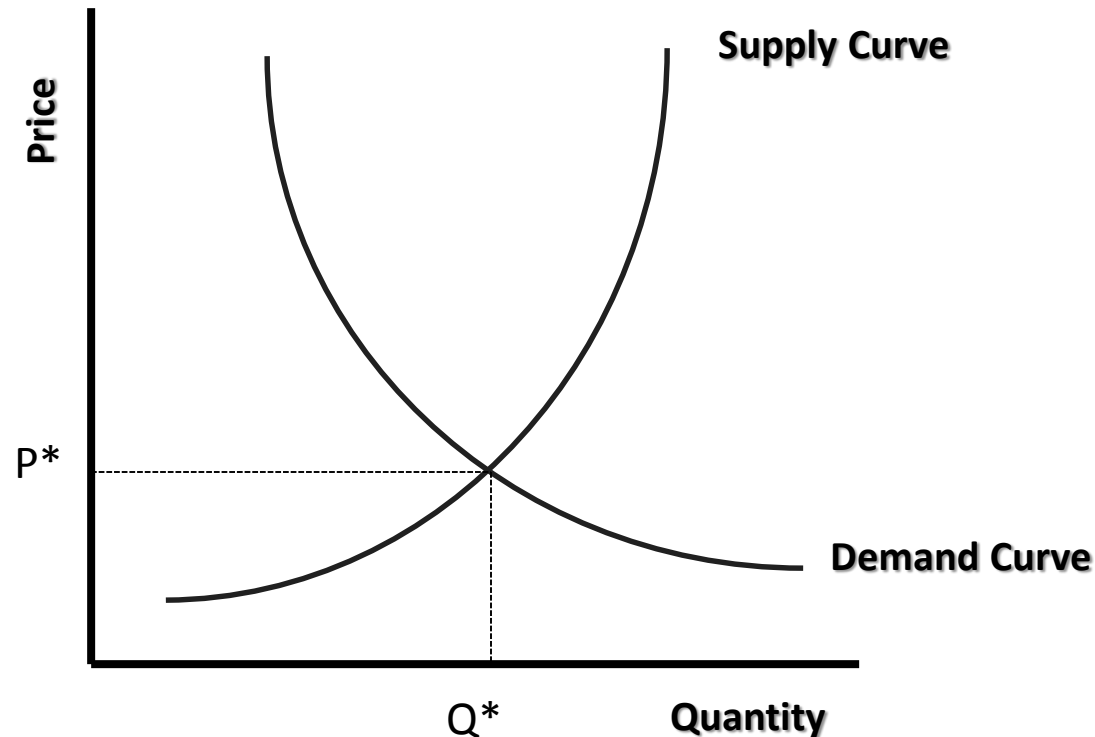
OR

~190 LITERS BIOJET



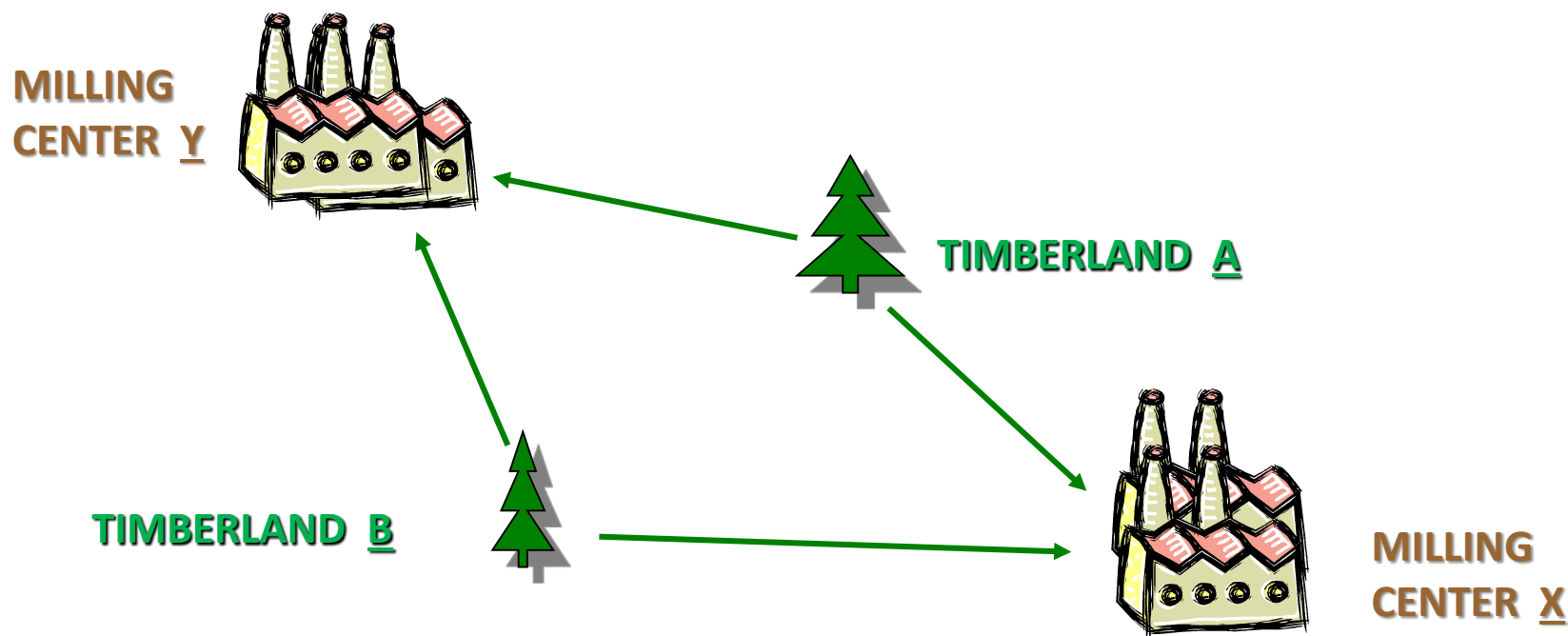
What is a Forest Sector Model?

- **Partial equilibrium model**
 - Price endogenous (one to many regions, one to many products)





How does a market model work?



MARKET BALANCE MUST BE FOUND ACROSS ALL MILLING CENTERS AND LOG SOURCES

LOG BUYERS TRADE-OFF SOURCES TO MINIMIZE COSTS

LOG SELLERS TRADE-OFF DESTINATIONS TO MAXIMIZE NET RETURNS



Why would NARA need such a model?

To evaluate site potential

Moving back a step

- its about log markets
 - Residues are called residues for a reason
 - You need an idea about primary markets
 - The past isn't always the best predictor of the future

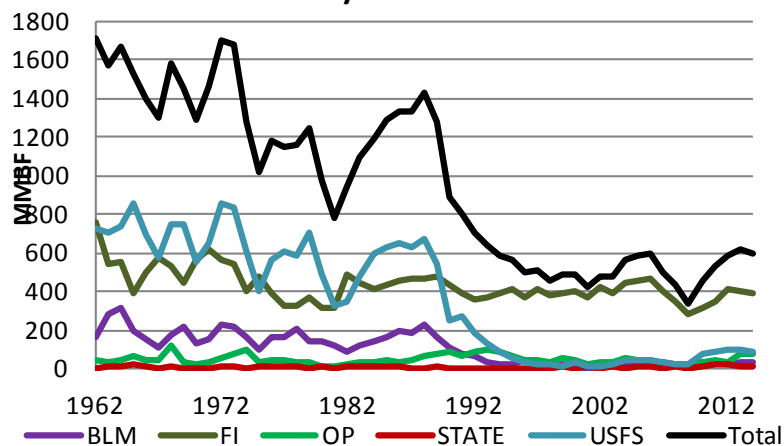


NARA

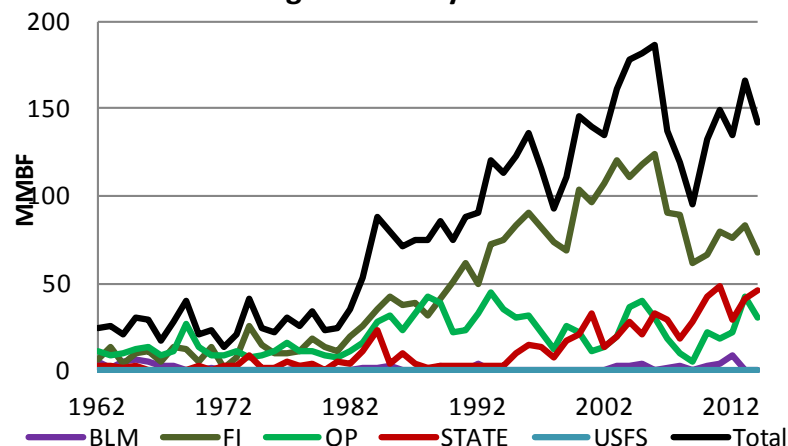


Why project log markets?

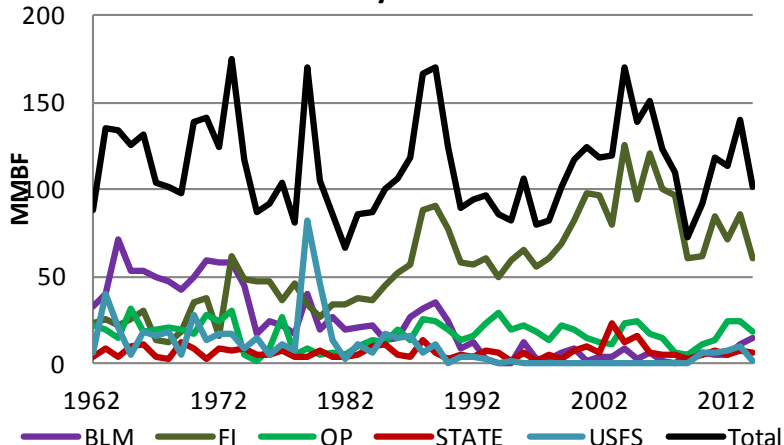
Lane County Timber Harvest



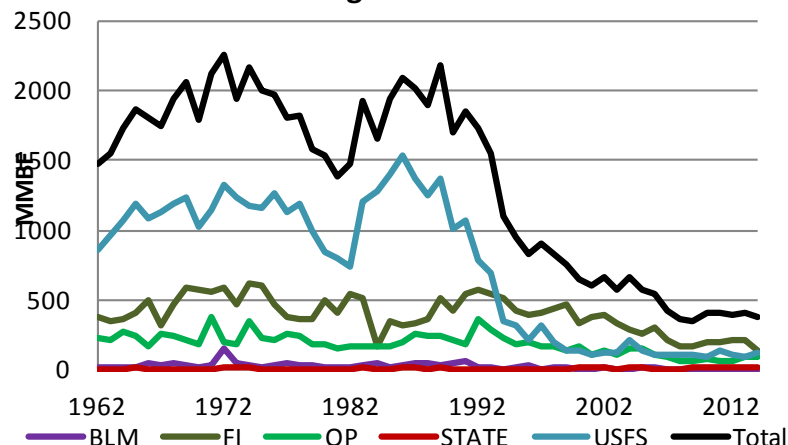
Washington County Timber Harvest



Benton County Timber Harvest



Eastern Oregon Timber Harvest





What does this market look like?

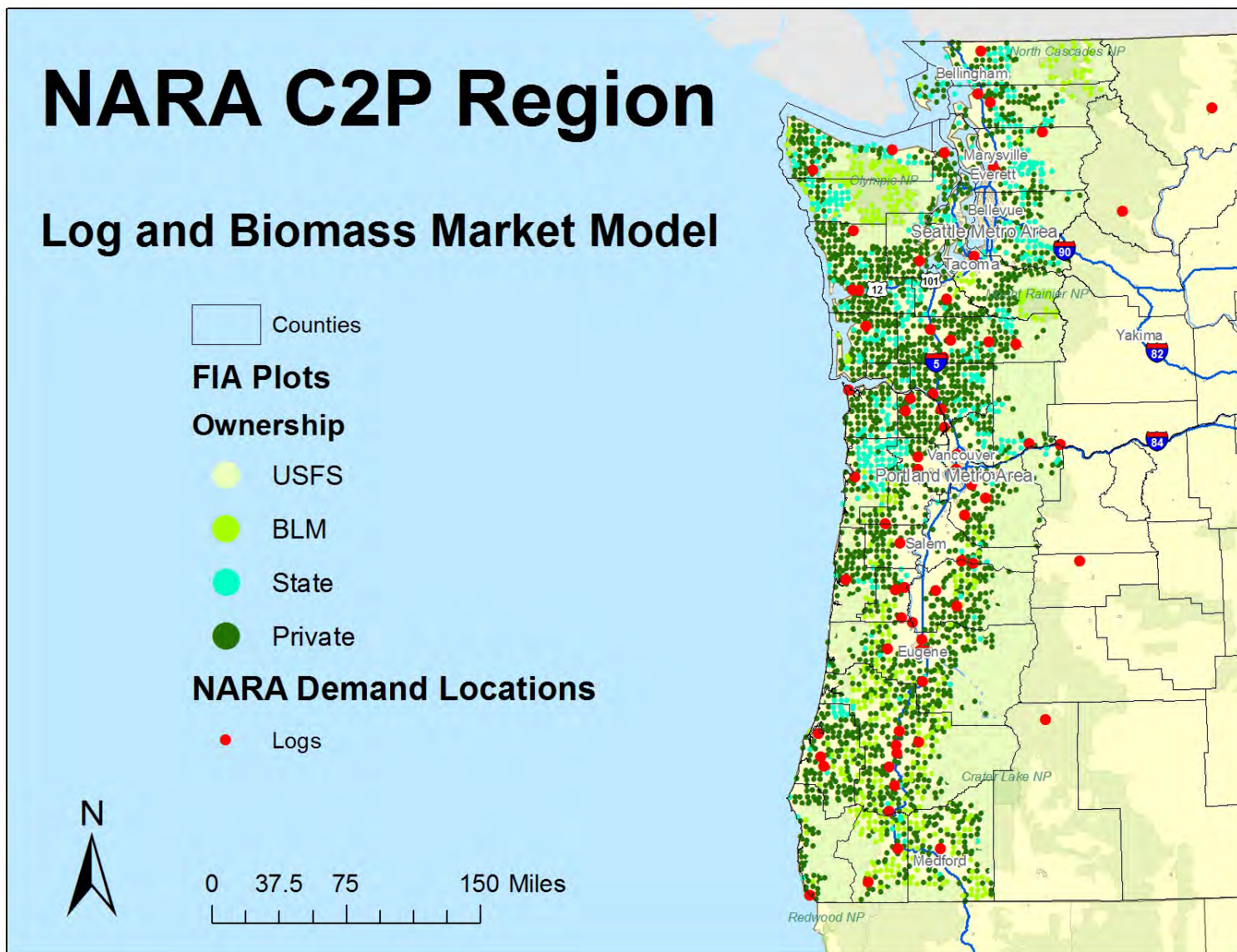
- FIA data forms the basis for supply
 - It tells us what is out there
 - And perhaps more importantly where
- Manufacturing forms the basis for demand
 - We know what mills are out there and what they make
 - And again, where



NARA



What does this market look like?

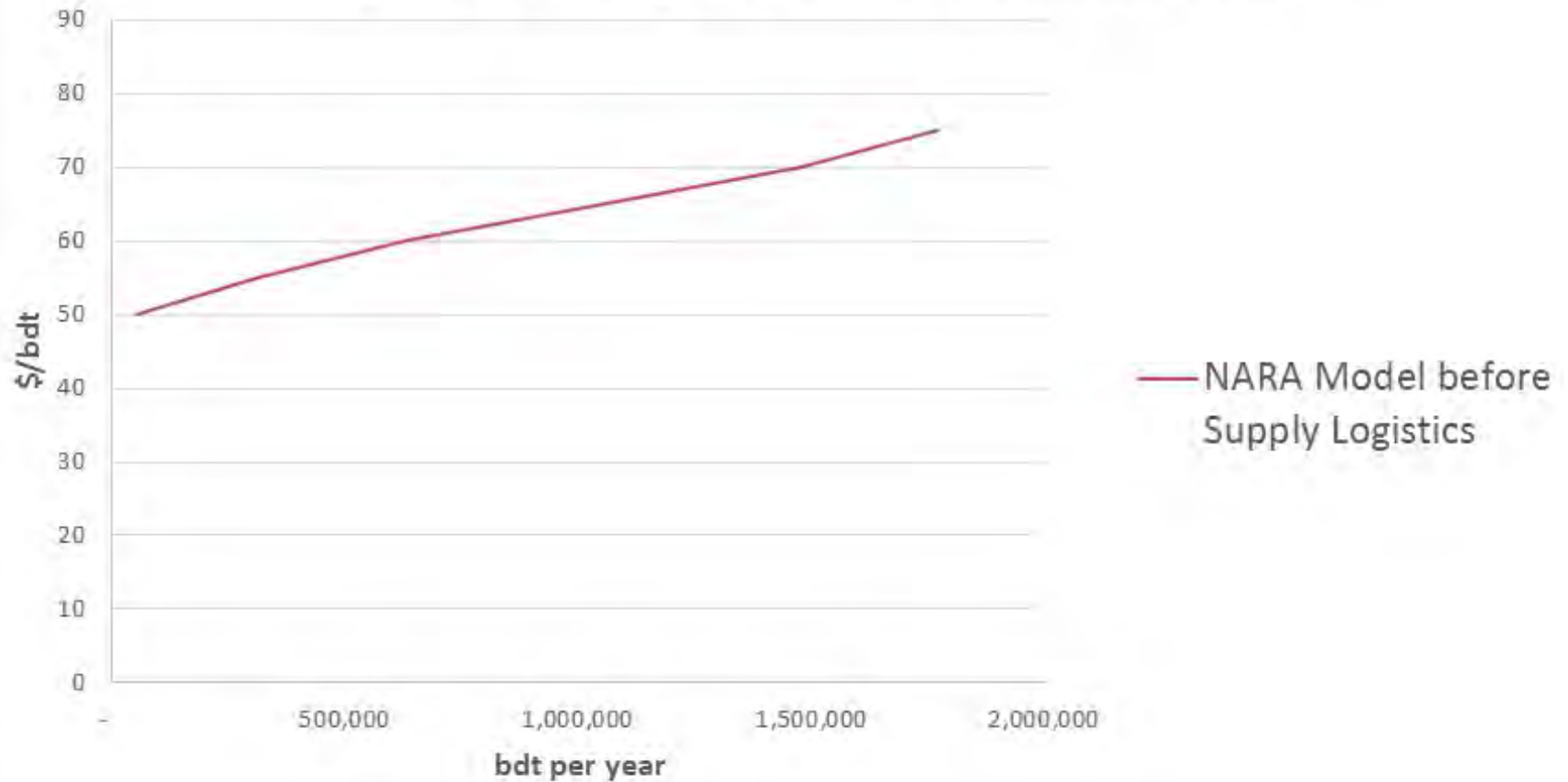


NARA



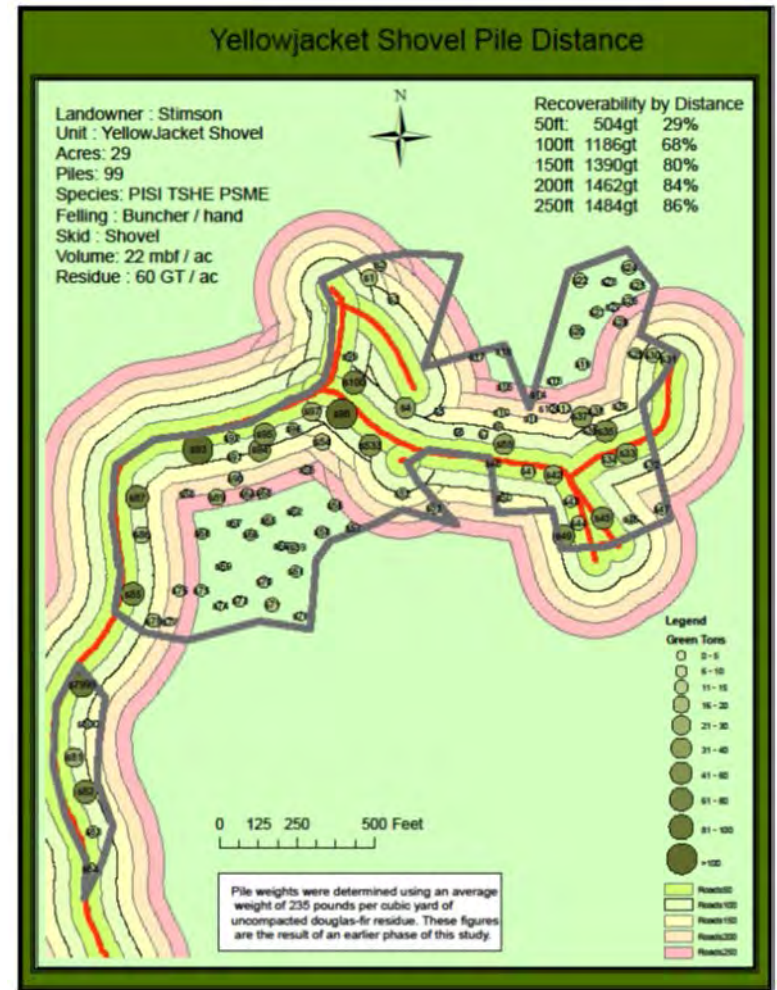
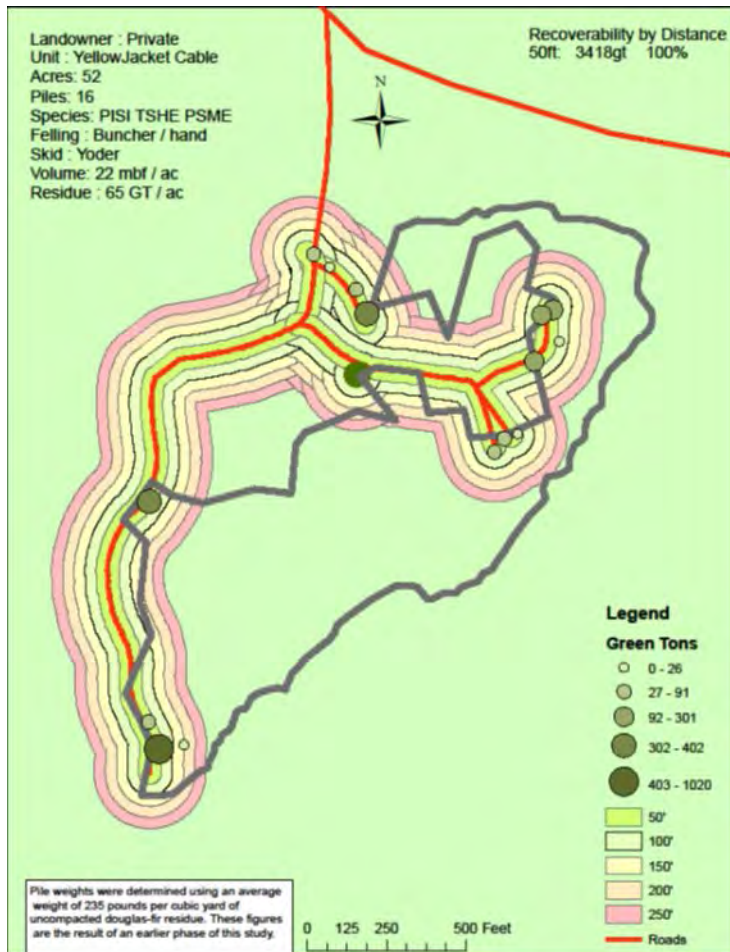
Biomass Supply Curve

Longview, WA logging residue delivered cost





Boston – What is in the pile



NARA



Boston – What is in the pile

Logging System Study site	Unit Area (Ac)	Residual Volume (Cy/Ac)	Transect Std. (Cy/Ac)	Total Biomass (Cy)	Percent In Piles
Mixed					
Fernhopper – WV	40.6	38	4.4	3,254	53.6%
Shovel					
Numskull - WV	70.2	42	4.8	6,883	59.4%
High Deck -CAS	9.8	21	17.6	796	75.0%
System Average					67.2%
Cable					
Shot Pouch - CAS	66.7	51	19.7	5,751	42.7%
Four Way – OC	60.7	45	12.8	4,630	41.9%
Euchre - OC	33.0	25	2,8	1,772	54.8%
System Average					46.5%



NARA



% Area by Harvest System and Distance from Road (NARA region composite)

REGION	# PLOTS	%AVAIL	G1 -150'	G2- 300'	G3 300+	%C
OR	1973	87.24%	11.14%	11.14%	43.88%	33.83%
WA	2093	87.61%	12.16%	12.16%	47.76%	27.92%
ID	675	89.83%	9.02%	9.02%	43.29%	38.67%
MT	1419	92.27%	2.86%	2.86%	66.29%	28.00%

WHERE

G1= GROUND-BASED SYSTEMS % LAND AREA 0-150' ROAD OFFSET

G2= GROUND-BASED SYSTEMS % LAND AREA 150-300' ROAD OFFSET

G3= GROUND-BASED SYSTEMS % LAND AREA > 300' + OFFSET

C= CABLE-BASED SYSTEMS % LAND AREA

% AVAIL = LAND AREA THAT HAS NOT BEEN RECENTLY HARVESTED

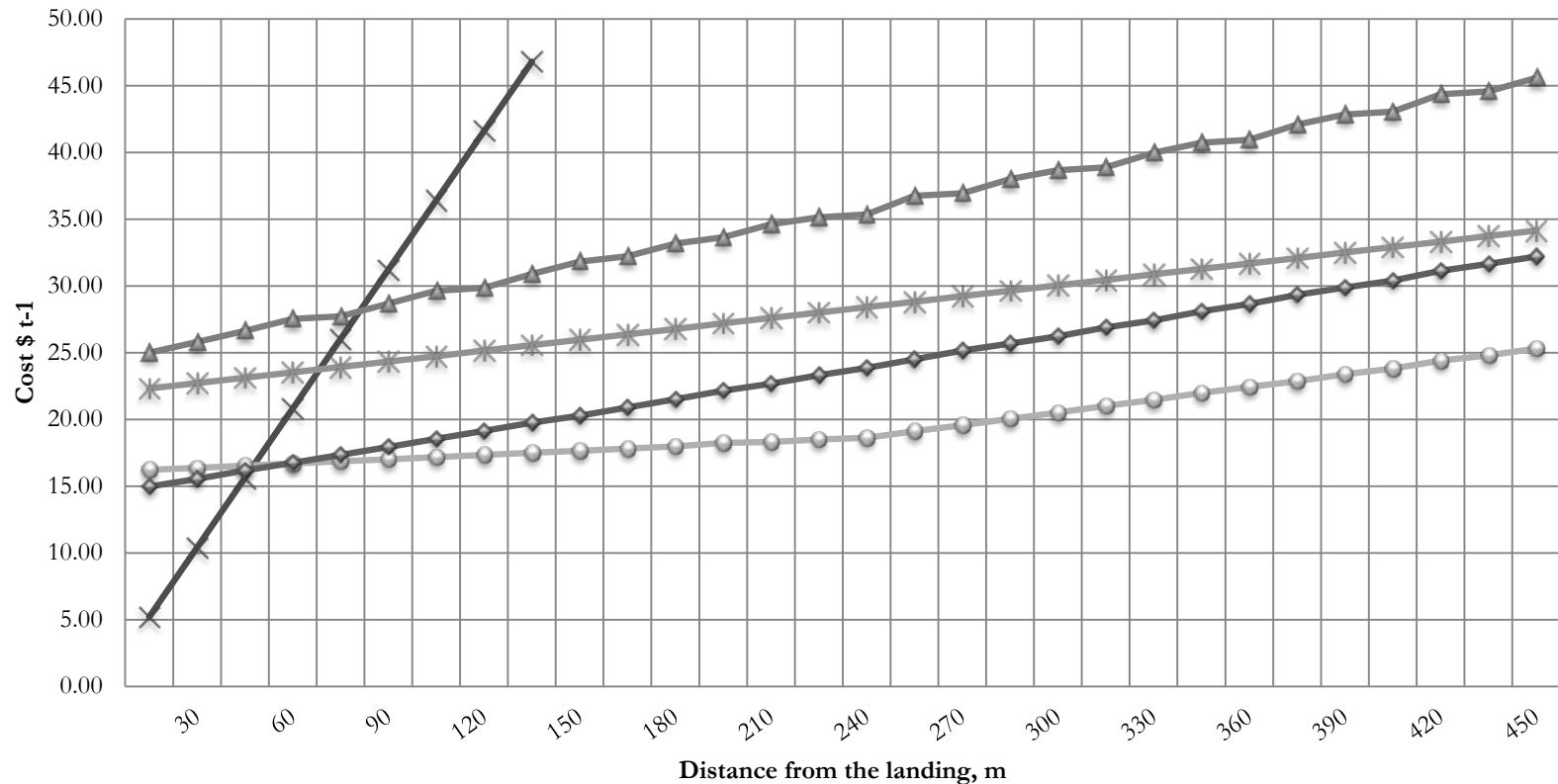
- State and Private FIA Plot Assessment (from Berry 2015)



NARA



Zamora/Sessions - Collection Costs



- Marginal cost (\$/BDT) to bring forest residues to landing as a function of collection method and distance to landing. Mobilization costs are not considered (from Zamora and Sessions 2015).



NARA



What does the harvest look like?

NARA C2P Region

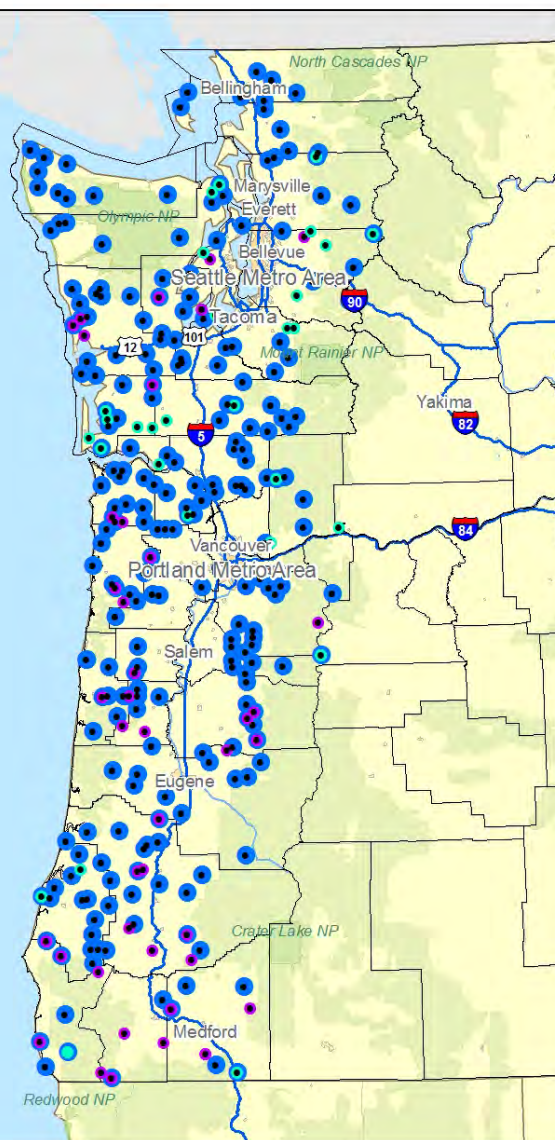
Log and Biomass Market Model

- 2015 Harvest for Pulp
- 2015 Harvest for Export
- 2015 Harvest for Plywood
- 2015 Harvest for Lumber

Counties



0 37.5 75 150 Miles



NARA



Biomass Model Assumptions

Cable In unit	Cable At landing	Ground At landing	Ground < 150'	Ground 150 – 300'	Ground 300' +
Availability <i>from Boston</i> 46.5% <i>from Berry</i> Plot specific <i>from Sessions</i> 75% swing	Availability <i>from Boston</i> 46.5% <i>from Berry</i> Plot specific <i>from Sessions</i> 25% no swing	Availability <i>from Boston</i> 67.2% <i>from Berry</i> Plot specific <i>from Sessions</i> 25% at landing	Availability <i>from Boston</i> 67.2% <i>from Berry</i> Plot specific <i>from Sessions</i> 75% in field	Availability <i>from Boston</i> 67.2% <i>from Berry</i> Plot specific <i>from Sessions</i> 75% in field	Availability <i>from Boston</i> 67.2% <i>from Berry</i> Plot specific <i>from Sessions</i> 75% in field
Costs <i>from Sessions</i> Collect 0.00 Grind 21.00 SwingBin 21.00 Wait 3.50	Costs <i>from Sessions</i> Collect 0.00 Grind 21.00 SwingBin 0.00 Wait 3.50	Costs <i>from Sessions</i> Collect 0.00 Grind 21.00 Wait 3.50	Costs <i>from Sessions</i> Collect 11.50 Grind 21.00 Wait 3.50	Costs <i>from Sessions</i> Collect 18.50 Grind 21.00 Wait 3.50	Costs <i>from Sessions</i> Collect 23.50 Grind 21.00 Wait 3.50

Landing

Older Assumptions for all ground: Collect 20.0

Grind 17.5

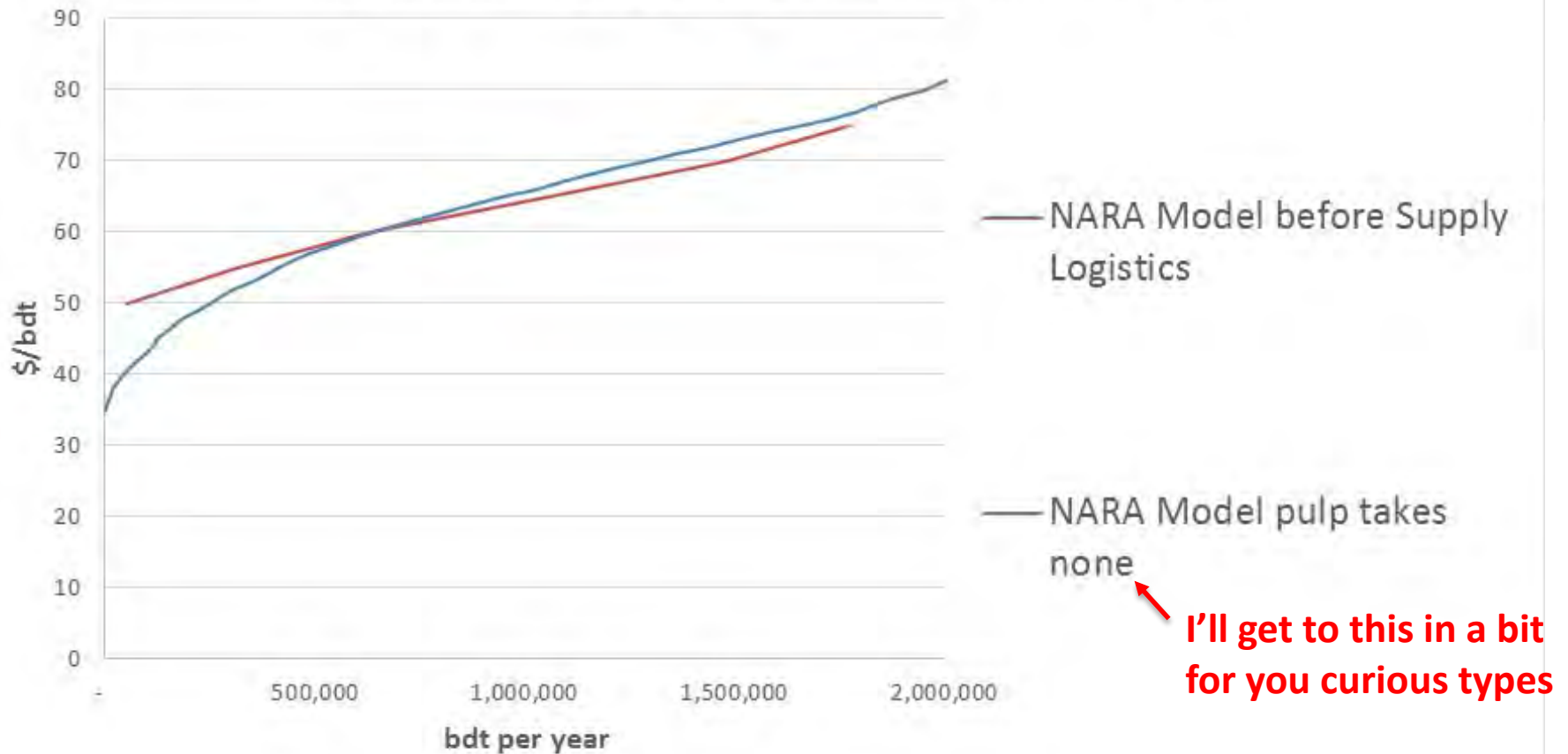
NARA





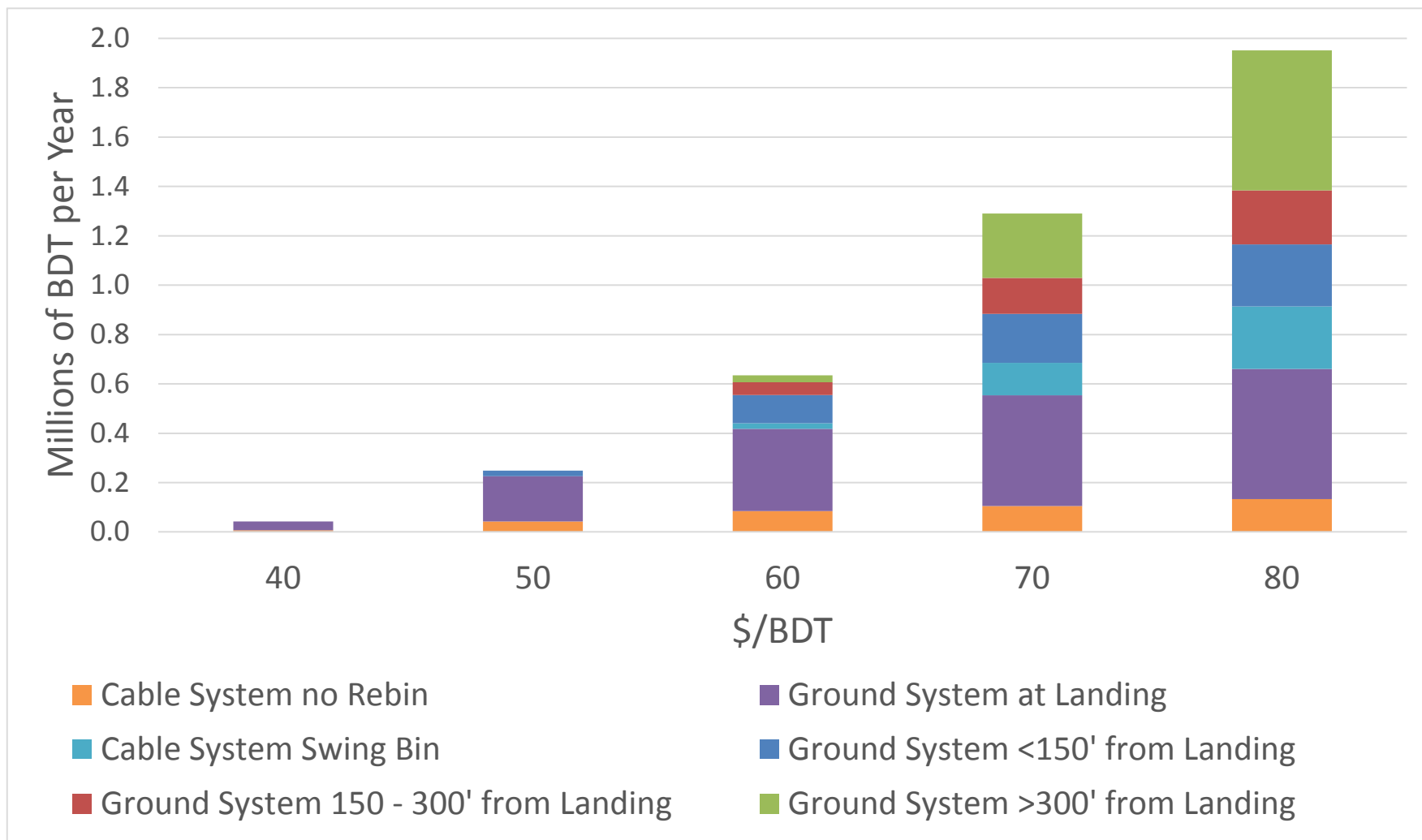
Biomass Supply Curve

Longview, WA logging residue delivered cost



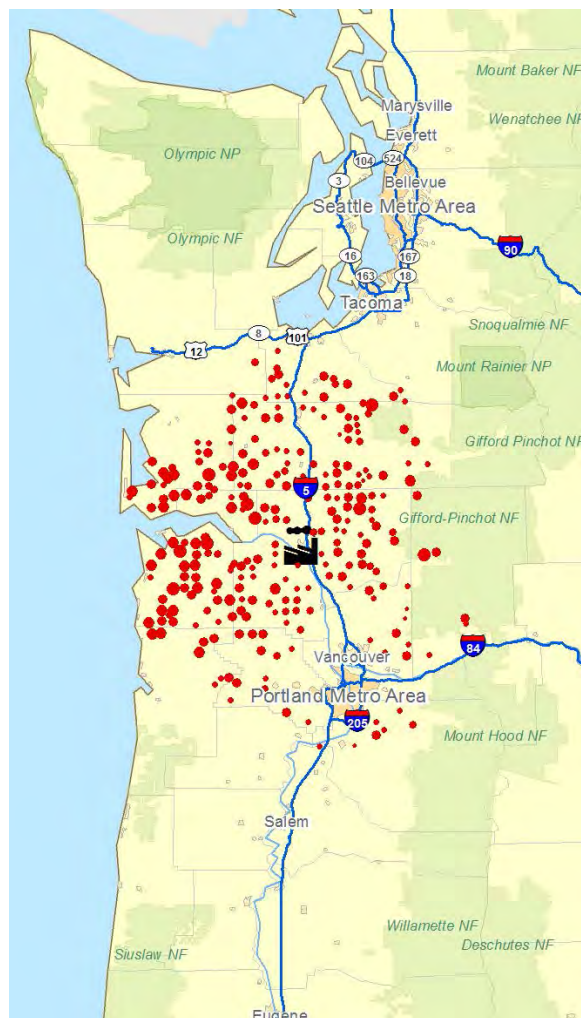


Disaggregated Biomass Supply Curve





Supply at \$65/bdt for Longview

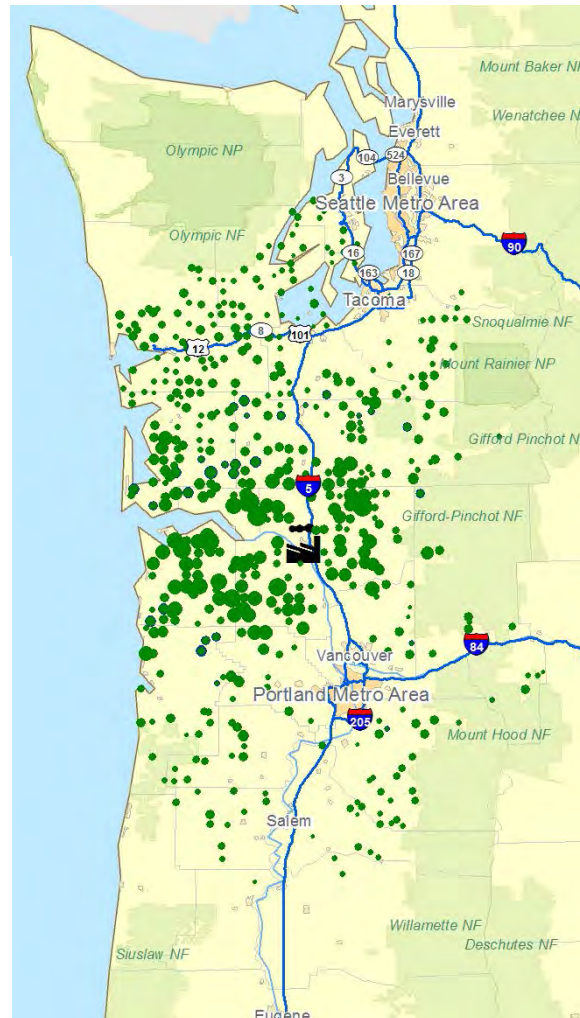


● Old 975,521 bdt/yr
● New 944,001 bdt/yr

Scale	
Bdt/year	
• 0 - 250	• 3500 - 4000
• 250 - 500	• 4000 - 4500
• 500 - 750	• 4500 - 5000
• 750 - 1000	• 5000 - 5500
• 1000 - 1500	• 5500 - 6000
• 1500 - 2000	• 6000 - 6500
• 2000 - 2500	• 6500 - 7000
• 2500 - 3000	• 7000 - 8000
• 3000 - 3500	• 8000 - 9000
	• 9000 - 10000
	• 10000 +



0 20 40 80 Miles





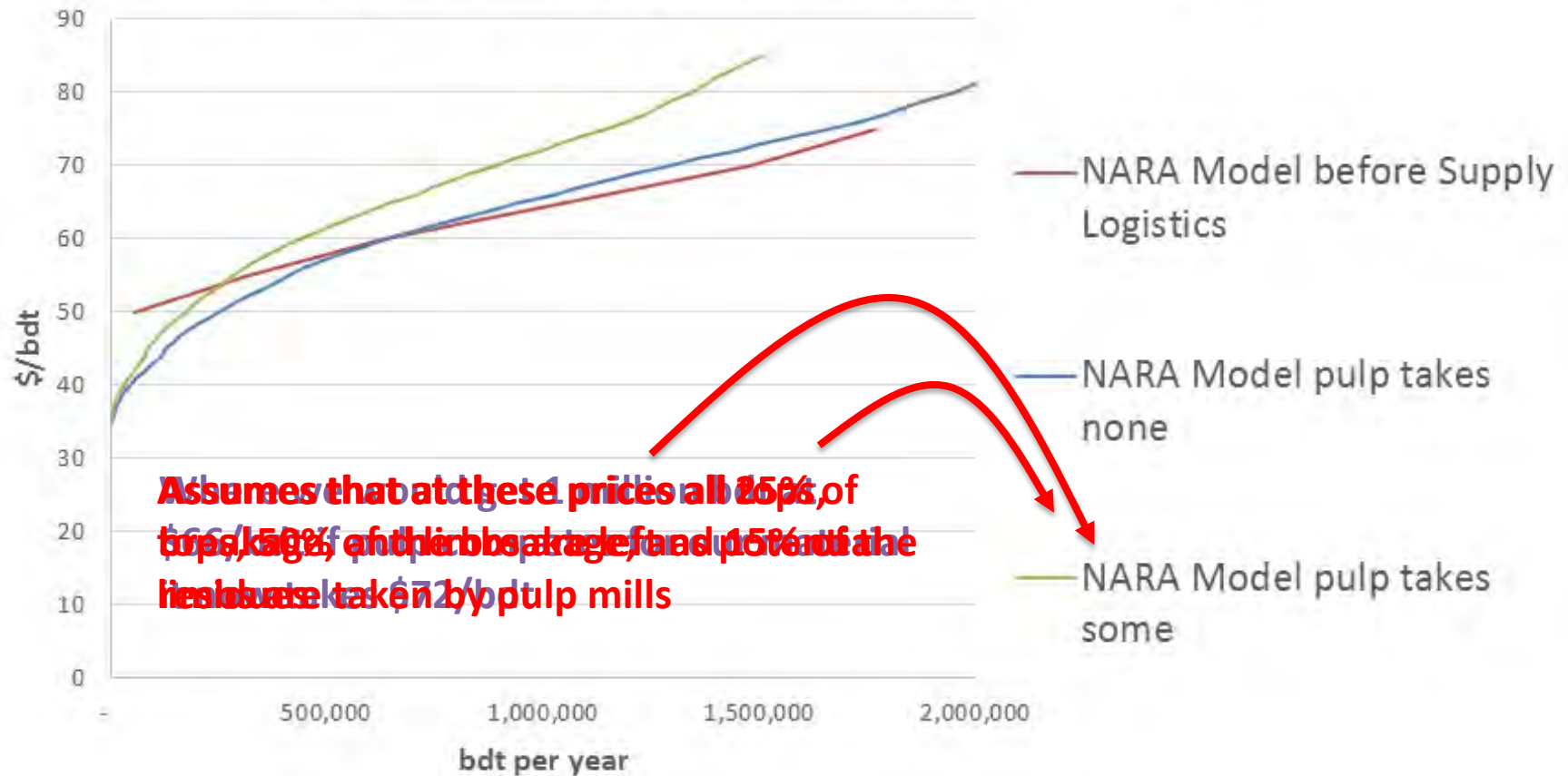
What about defect?

- We've got great information on where the material is and how much it will cost to collect and transport it, yet the question of how much material there is is still there
- We assumed 15% defect
- What if we didn't



Biomass Supply Curve

Longview, WA logging residue delivered cost





TPO Allometric Studies

TPO data is used to refine the 15% defect assumption?

- University of Montana Bureau of Business and Economic Research: Logging Utilization Research
 - Logging residues are estimated by sampling recently felled trees in active logging sites before trees are yarded to a landing.
 - The ratio of growing-stock residue volume/mill delivered volume can be applied to planned timber harvest volumes to predict residue production at the stand, landscape, or state-level.
 - For example - the residue ratio = 29 cubic feet of growing-stock residue generated per 1,000 cubic feet of mill-delivered volume for the 4-state NARA project area (2008-2013 data).
 - Bole, branch, and foliar biomass (i.e., non-growing stock portions of logging) residues can then be estimated with allometric equations.



NARA



Forest Products Markets

24
comments

Newberg pulp, paper mill to close 'indefinitely'; more than 200 jobs affected



By Allan Brettman | The Oregonian/OregonLive

Email the author | Follow on Twitter

on October 16, 2015 at 12:17 PM, updated October 16, 2015 at 2:33 PM

Print
Email

9
comments



0
shares

SP Fiber Technologies, a Newberg pulp and paper company, will close "indefinitely" in mid-November and could result in the layoffs of about 200 workers.

WestRock Co., which acquired the mill and other assets earlier this month, has announced that it will "idle indefinitely" the Newberg mill within weeks.

Representatives for WestRock Co., the Richmond, Va., company that [announced Oct. 1](#) it had purchased the Newberg mill along with other assets, delivered the news at the mill Thursday, according to an official in the Newberg city manager's office.

The closure is not necessarily permanent but there's no immediate plan to resume operations, SP Fiber Technologies human resources manager Stace Gordon informed Newberg City Manager Pro Tem Steve Rhodes. Gordon told Rhodes that the indefinite closure was related to "business conditions," according to an email provided to The Oregonian/Oregonlive by the City of Newberg.

WestRock and mill officials said the Newberg mill was one of three WestRock mills to be idled, said Bill Martello, area representative for the Association of Western Pulp and Paper Workers, Local 60, who met with the group.

An idled plant "is held in a ready-to-go state," said Martello, with property and machinery maintained to resume operations.

Of market conditions that affected the decision, Martello said, "The newsprint

Report: There may be hope yet for Newberg paper mill



By Allan Brettman | The Oregonian/OregonLive

Email the author | Follow on Twitter

on October 19, 2015 at 5:39 PM, updated October 19, 2015 at 5:53 PM

Print
Email



0
shares

A company that is "[idling indefinitely](#)" a Newberg paper mill also announced last week that it is closing a mill in Ohio and earlier this month took similar steps with two other mills. An industry newsletter, though, offered hope Monday that the Newberg mill could be spared from a permanent closure.

SP Fiber Technologies of Newberg will close "indefinitely" in mid-November, endangering about 200 jobs. Virginia-based mill owner WestRock Co. told Newberg employees its plan Thursday, two weeks after it announced it had purchased the Yamhill County mill along with other SP Fiber assets.

WestRock is cutting back as the demand for many paper products declines, inventories remain high and export demand declines in part because of the strength of the dollar, [industry observers](#) say.

Last week, WestRock confirmed it is closing a [paper mill in Coshocton, Ohio](#), by the end of November, eliminating jobs for 180 hourly workers and 45 salaried employees. And earlier this month, WestRock officials said the paper mill in Uncasville, Connecticut, would be "indefinitely idled" and another mill, in Fernandina Beach, Florida, would have one of its paper machines shut down.

In all, six machines at the four mills with capacity to produce 1.15 million tons a year of containerboard and 220,000 tons a year of newsprint are affected, according to the industry publication PPI Pulp & Paper Week.

Meanwhile, an analysis of the shutdowns by KeyBanc Capital Markets published Monday said WestRock "is reportedly planning to restart the Newberg mill after some capital investments and changes in grade mix." The analysis cited the

SEASON of
SHARING

Supporting
stories of hope
in Oregon.

GIVE TODAY

TODAY'S BUSINESS UPDATE

The top business headlines of the day delivered to your inbox.

Enter your e-mail address OPTIONAL
Enter Zip

Subscribe

☐ Check here if you do not want to receive additional email offers and information.

[See our privacy policy](#)

BUSINESS NEWS VIDEOS

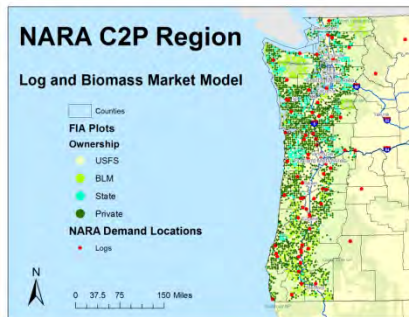
Video: 25 seconds



NARA



A Two Model Approach



Regional

Log Market

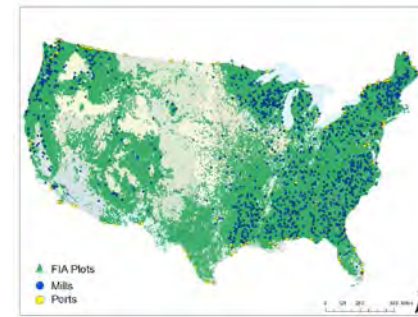
Can do sensitivity analyses for products but have to translate it to log demand

Individual tree growth

Can provide sensitivity linkages with detailed sustainability studies in C2P

Long-run optimal outlook

5-year periods for longer time frame to get optimal silviculture which drives the long-run log demand



National

Product Market

Can do sensitivity analyses for product demand based on AEO scenarios

Stand-level growth

Can provide carbon values, but little other detail for sustainability measures

Short-run “likely” outlook

1-year periods for shorter time frame with limited silviculture. Macroeconomic conditions drive demand.



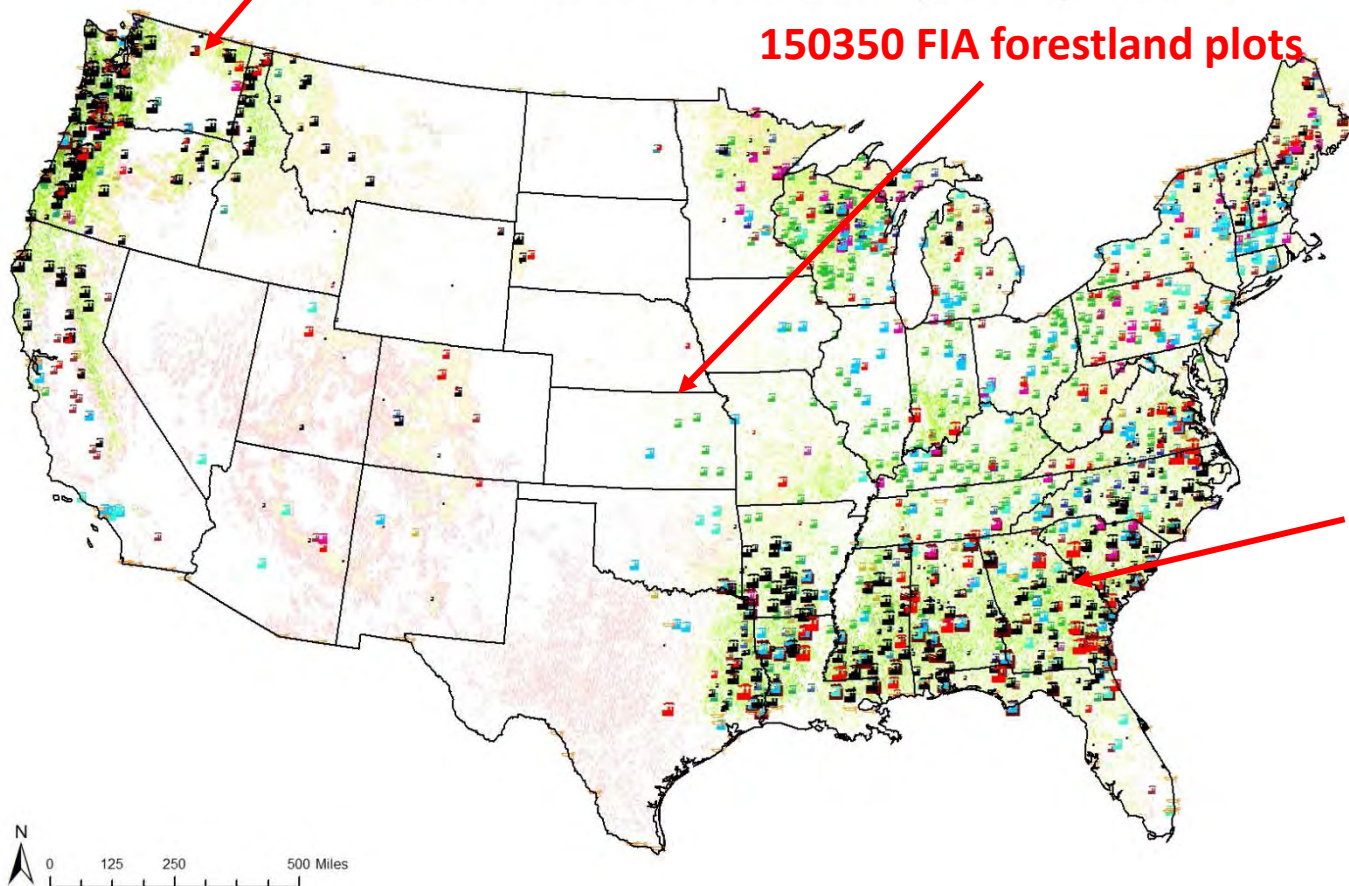
Combined Forest Sector

126 Ports / Border crossings

Land Use and Resource Allocation (LURA) Model

150350 FIA forestland plots

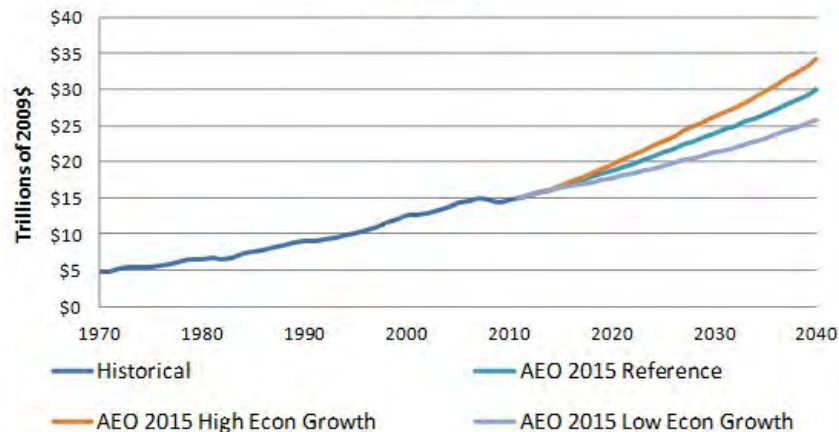
**1770
Manufacturing
facilities**



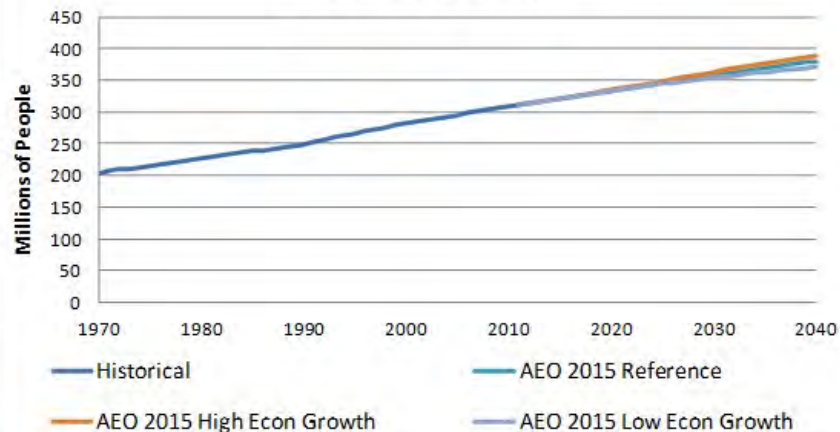


LURA Forest Demand Drivers

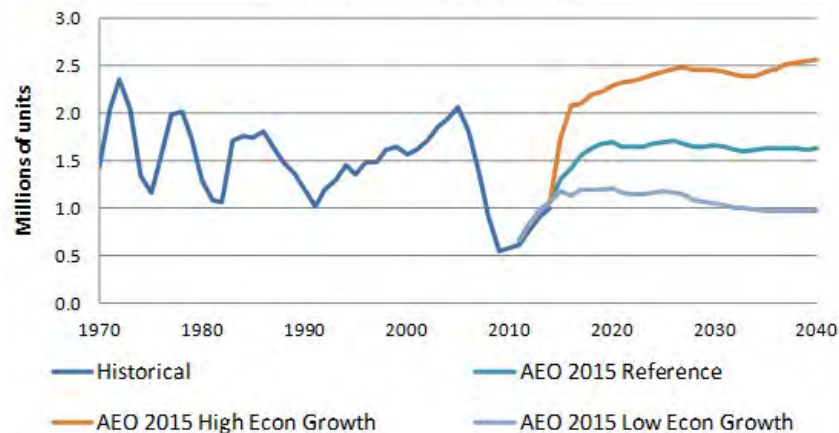
U.S. GDP



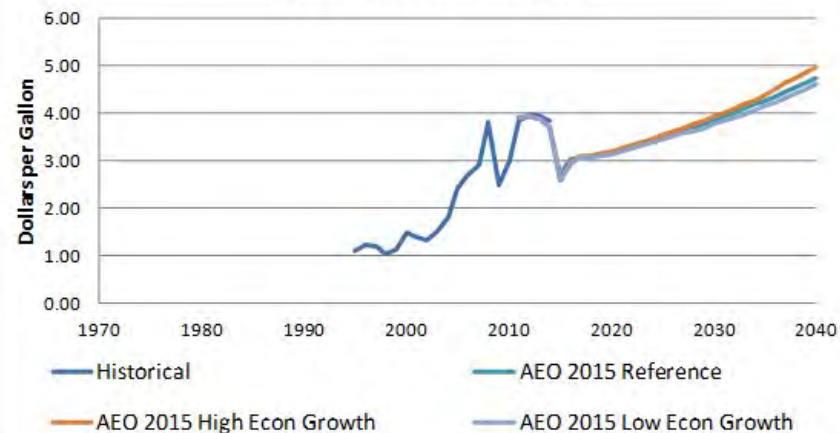
U.S. Population



U.S. Housing Starts

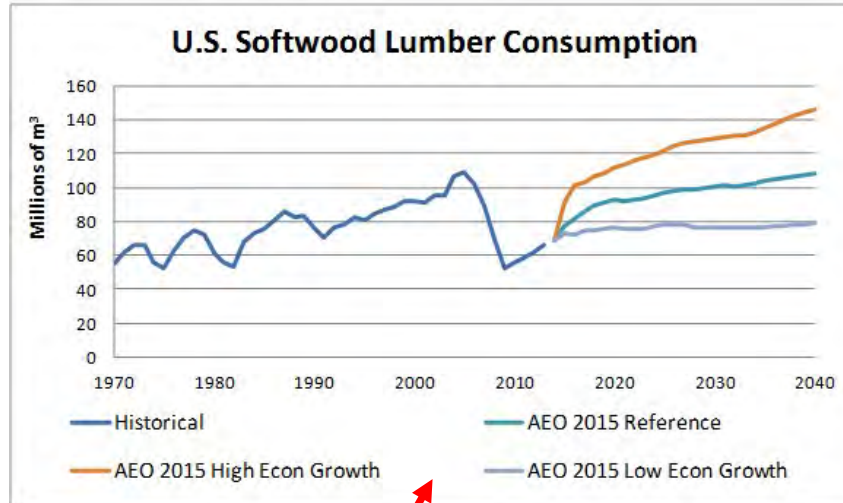


U.S. Diesel Fuel Price

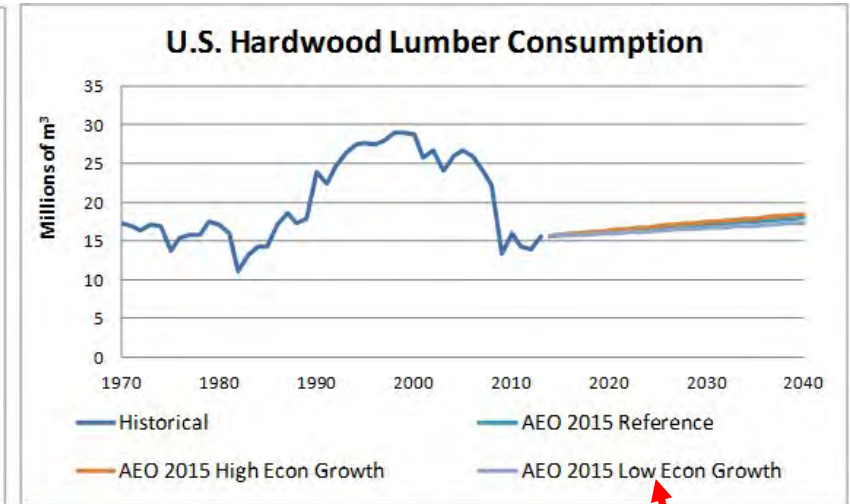




LURA Forest Demand

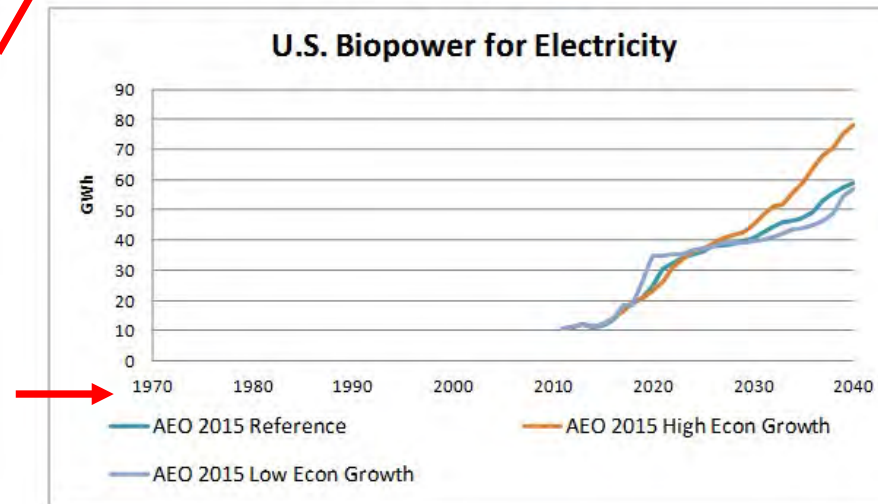


Driven by GDP and housing starts



Driven by GDP

Taken directly from AEO 2015



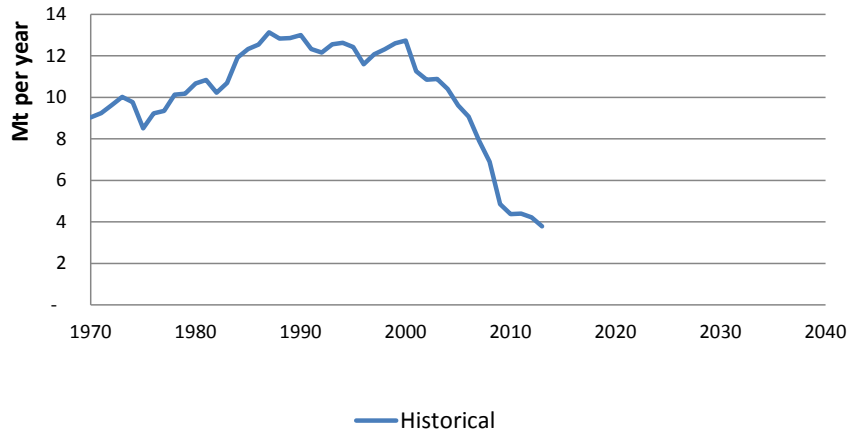
USDA

NARA

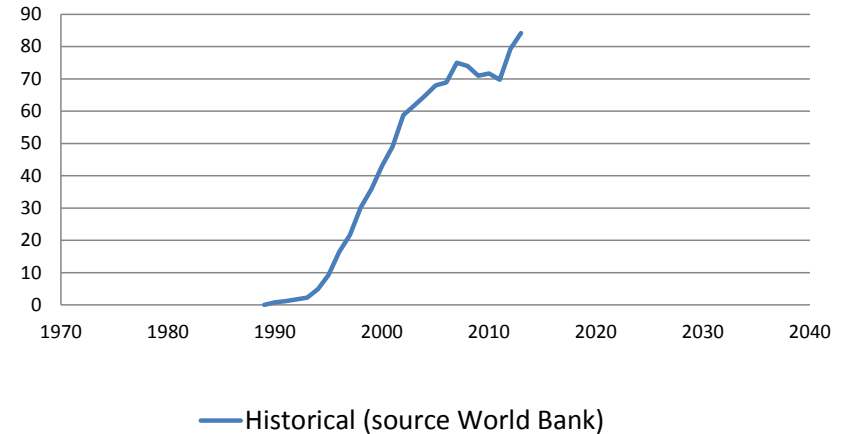


Paper Product Demand

U.S. Newsprint Consumption



U.S. Internet Users per 100 People



From: USDA NIFA Forest Mortality, Economics and Climate in Western North America (FMEC) Project

- Uses GDP per capita and Internet use to generate elasticities that vary by GDP level
- At current US internet use levels GDP elasticity is negative for Newsprint and Printing and writing papers, but positive for Paperboard and Tissue which were found to be unrelated to internet

Latta, G, A.J. Plantinga, and M. Sloggy. *In Press*. The effects of internet use on global demand for paper products. *Journal of Forestry*.

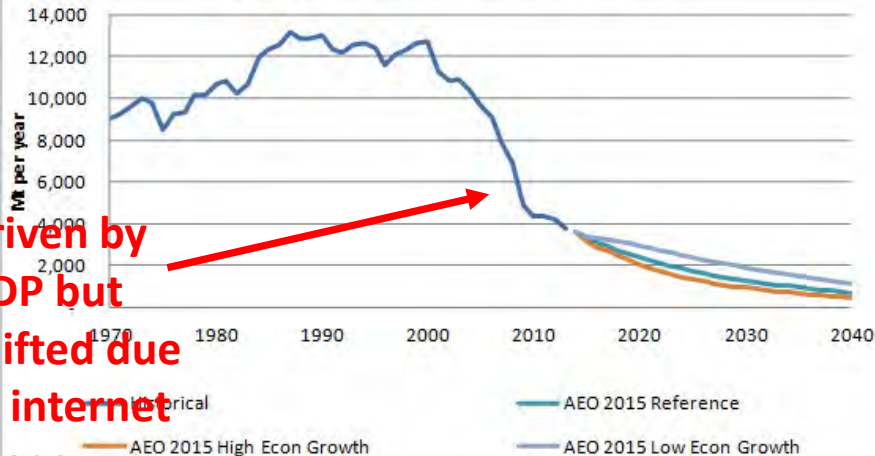


NARA

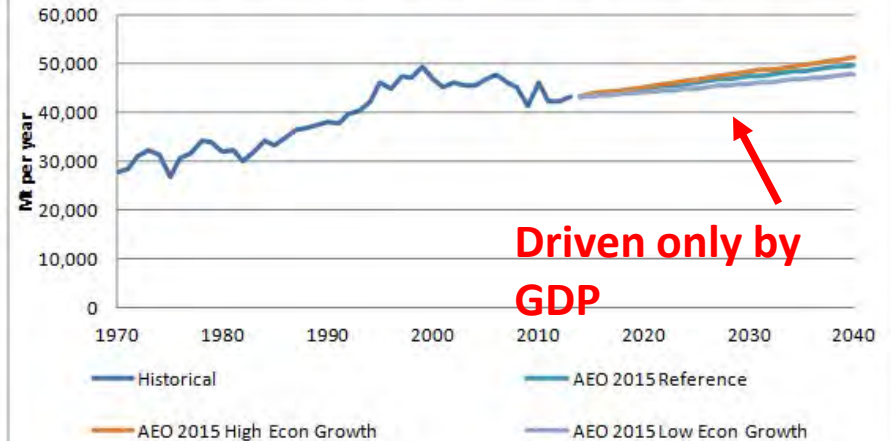


LURA Forest Demand

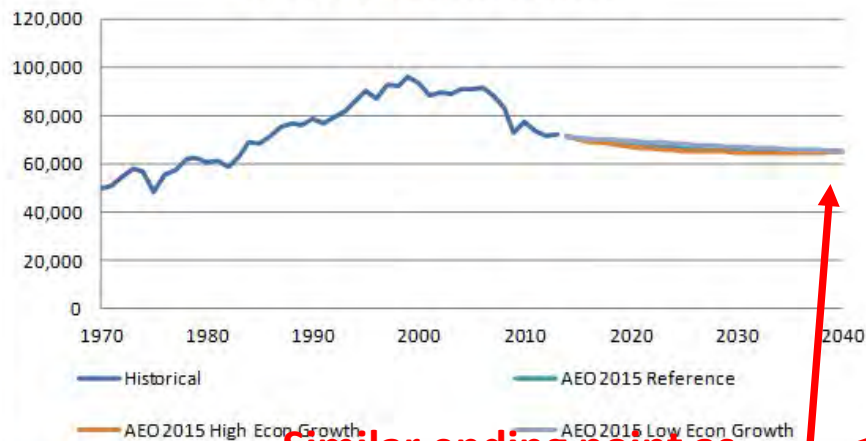
U.S. Newsprint Consumption



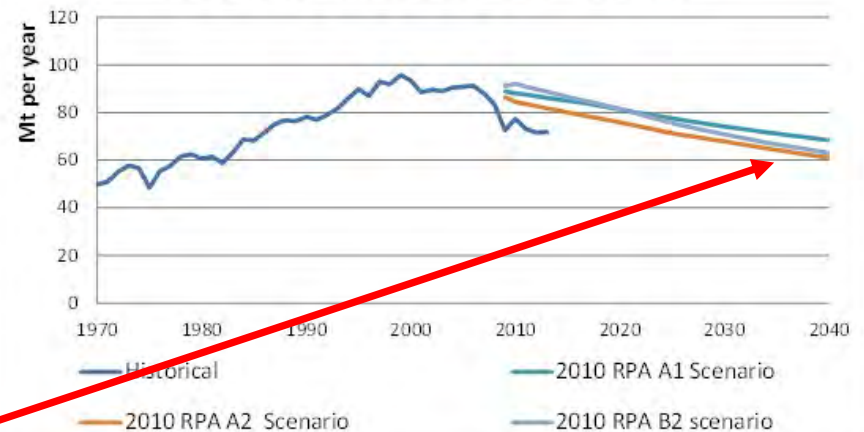
U.S. Other Paper and Paperboard Consumption



U.S. Paper Consumption



2010 RPA U.S. Paper Consumption

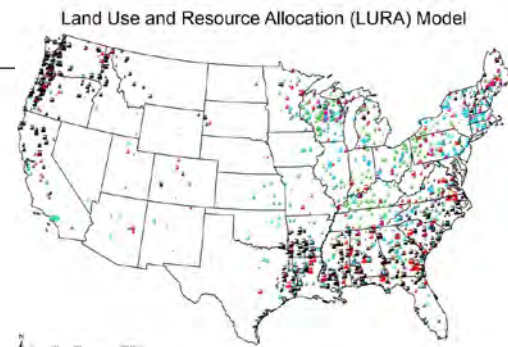
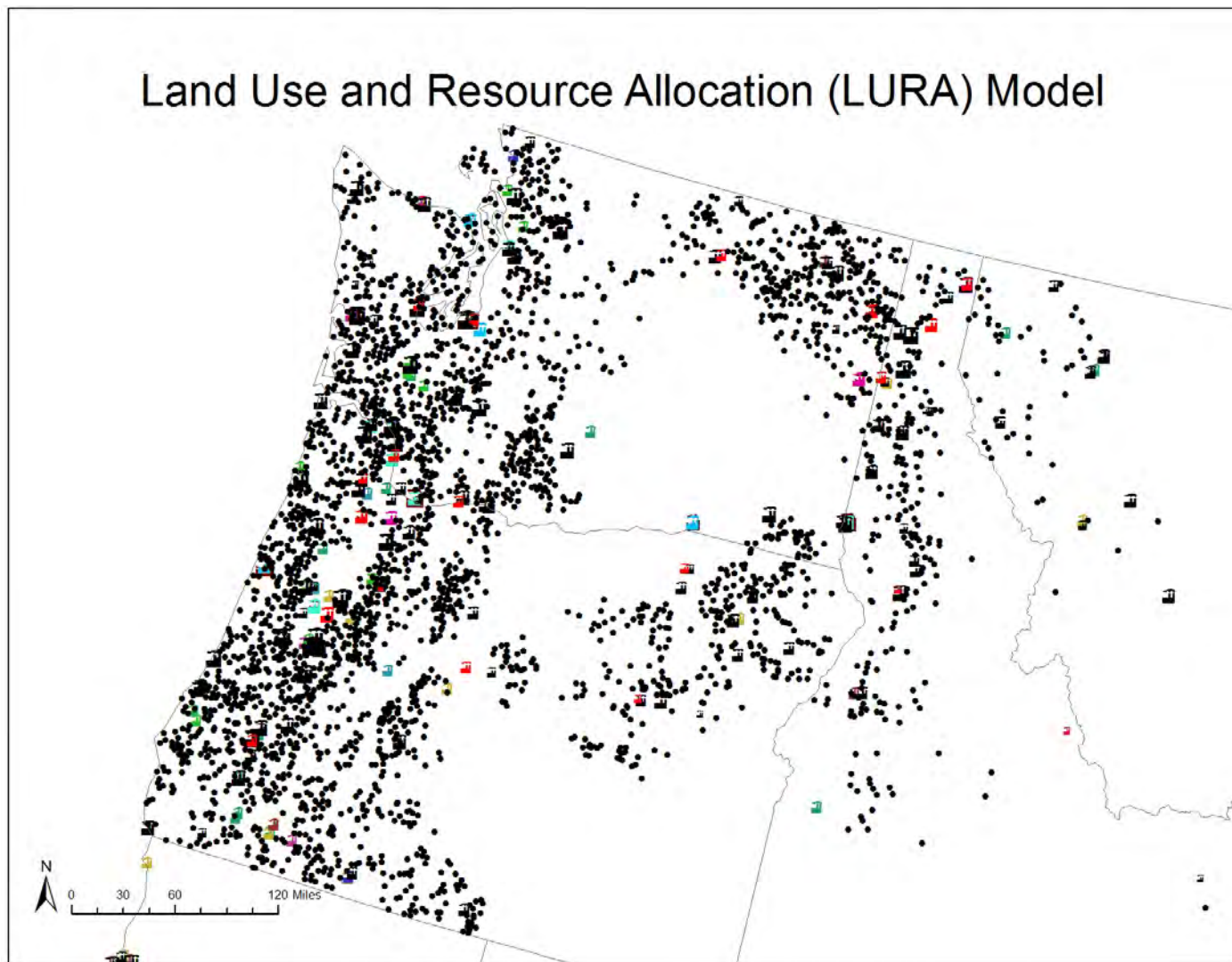


Similar ending point as
2010 RPA, but different
path there



What does the harvest look like?

Land Use and Resource Allocation (LURA) Model



LURA Mills

Product (# of facilities)

- BioPower (87)
- For_Pellets (139)
- HW_Lumber (290)
- HW_Plywood (29)
- Hardboard (19)
- Insul_Board (49)
- MDF (15)
- Newsprint (11)
- OSB (39)
- P_W_Paper (82)
- PaperBoard (189)
- Pulp_Chem (117)
- Pulp_Mech (19)
- SW_Lumber (561)
- SW_Plywood (57)
- Tissue (67)



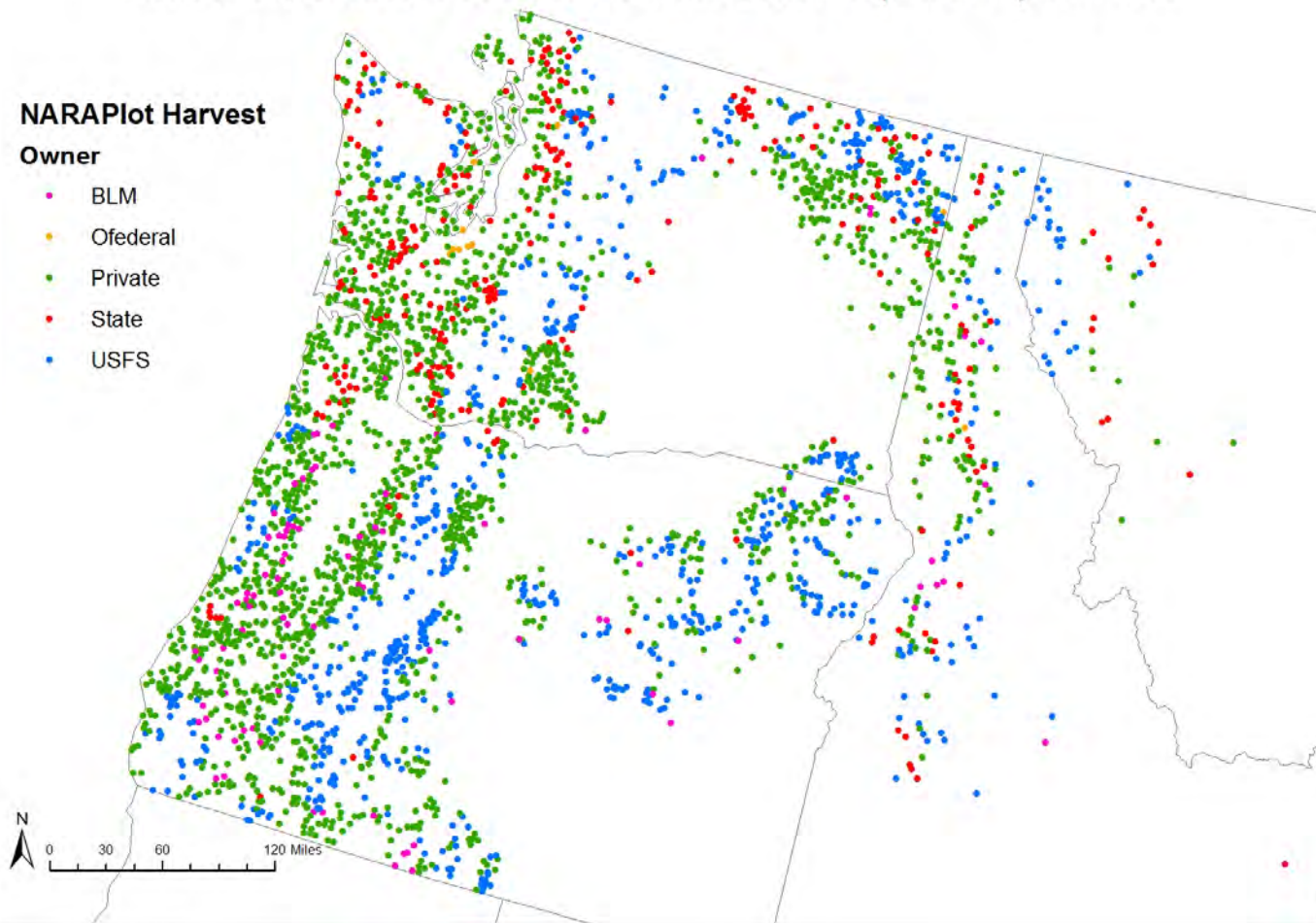
What does the harvest look like?

Land Use and Resource Allocation (LURA) Model

NARAPlot Harvest

Owner

- BLM
- Ofederal
- Private
- State
- USFS

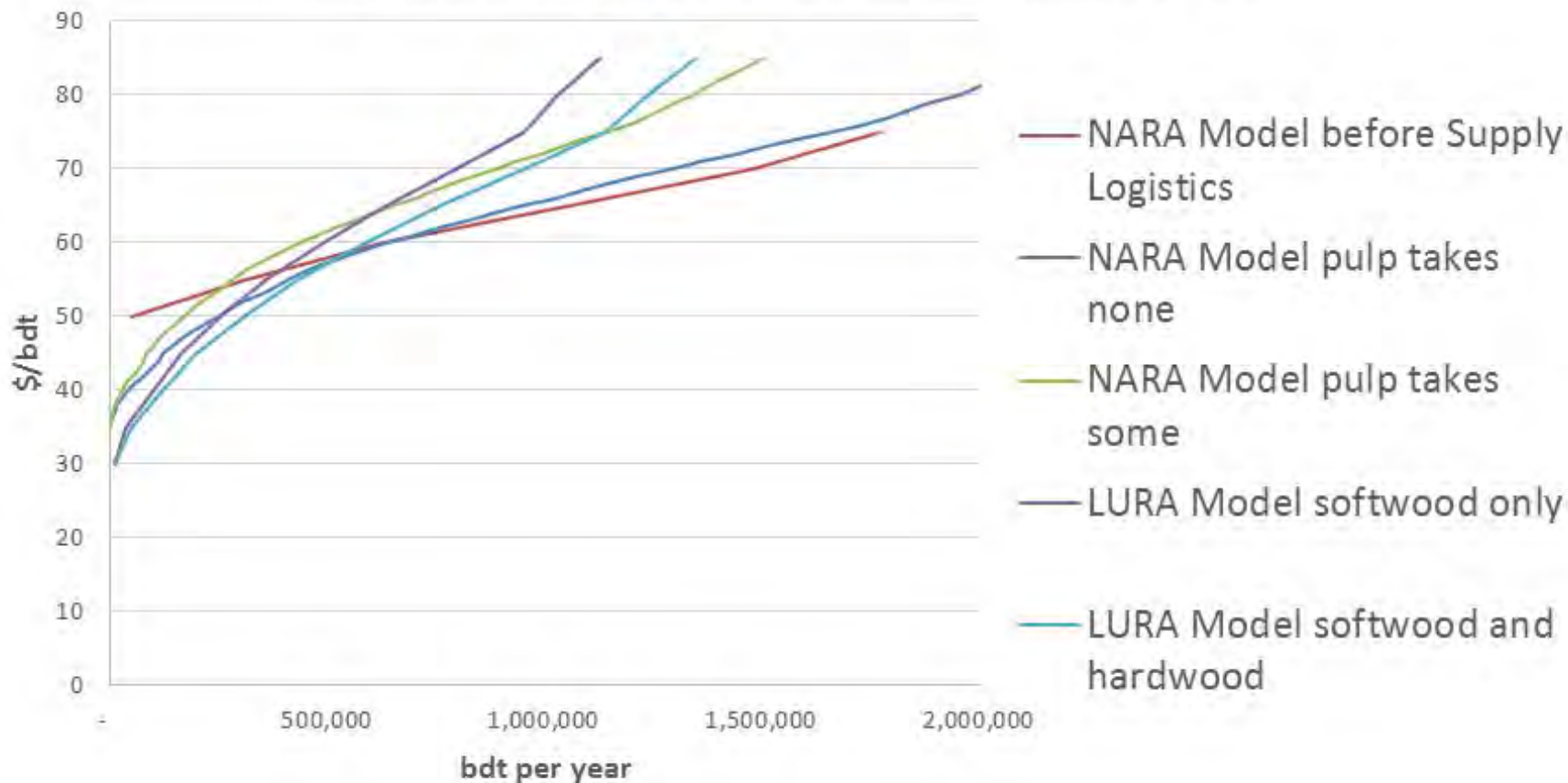


NARA



Refined Biomass Supply Curves

Longview, WA logging residue delivered cost





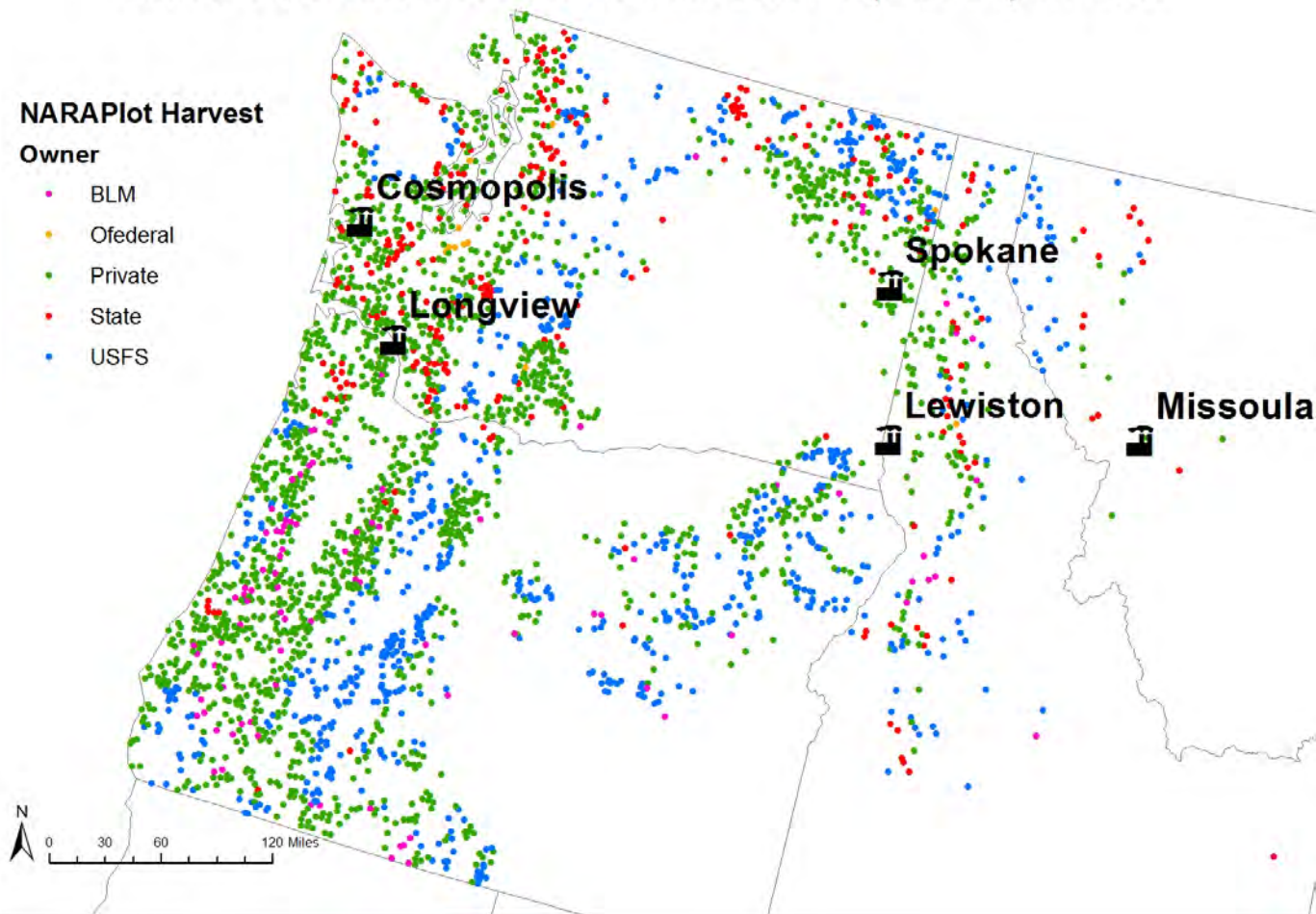
What does the harvest look like?

Land Use and Resource Allocation (LURA) Model

NARAPlot Harvest

Owner

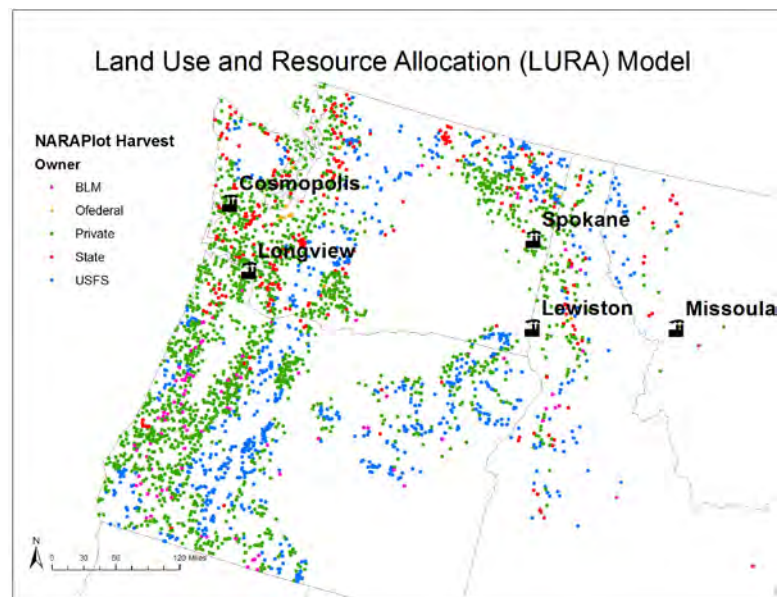
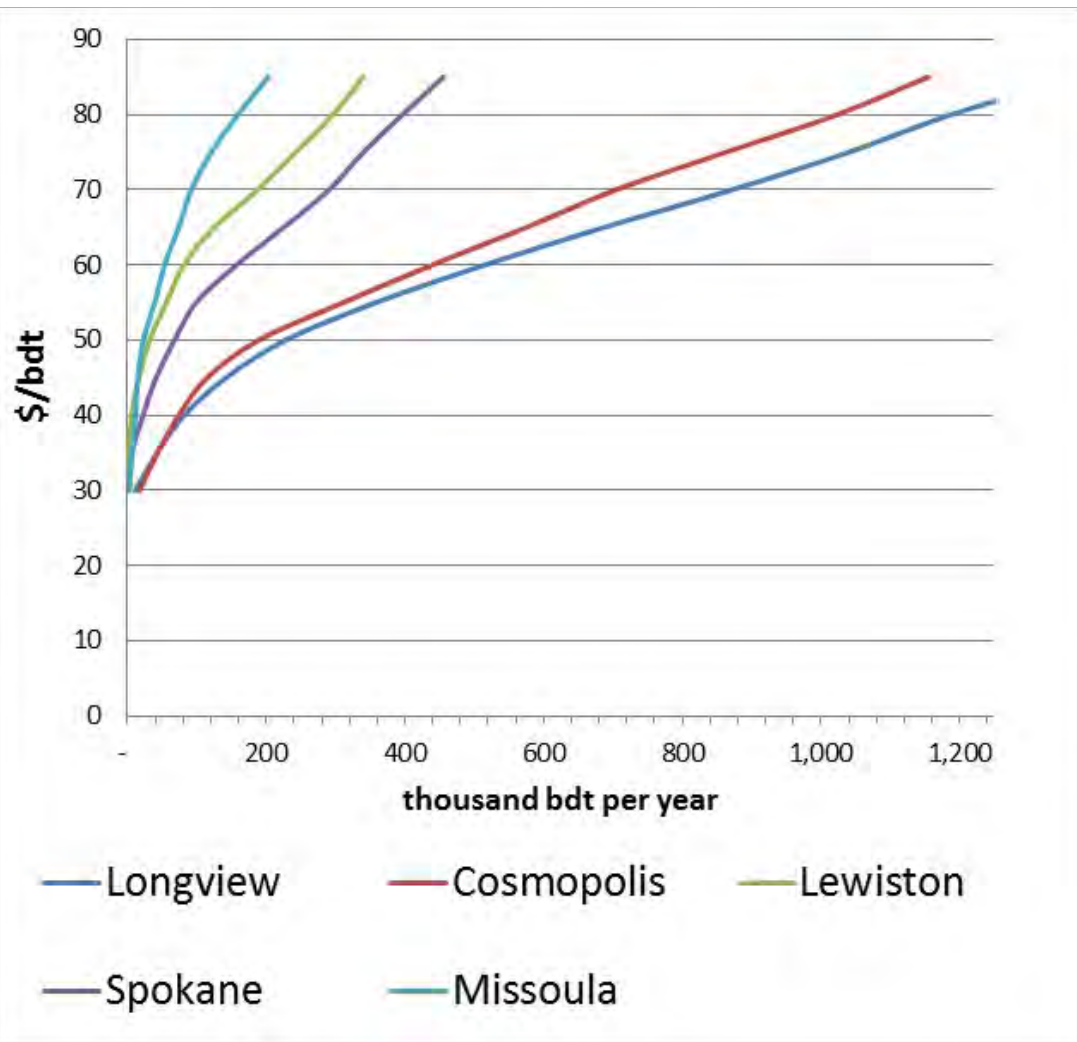
- BLM
- Ofederal
- Private
- State
- USFS



NARA



Biomass Supply Curves (avg 2015-2035)





NARA biomass model – moving on

- We've seen an example of the supply chain linkage here
 - We are evaluating multiple sites across (OR, WA, ID & MT)
 - We need to refine and improve the forest products spatial information (capacities etc)
- Also linkages to sustainability
 - Nutrients (Maguire)
 - Soils (Hatten)
 - Habitat (Betts)



Non-traditional (or are they) sources

SUSTAINABLE BUSINESS OREGON

Newberg paper mill closure leaves few options for Metro's 127K tons of Portland scrap wood

Nov 3, 2015, 5:55am PST Updated Nov 3, 2015, 10:57am PST

INDUSTRIES & TAGS [Energy](#), [Biomass](#), [Forestry](#), [Sustainability](#)

SHARE     

 Order Reprints  Save Article 

Get Portland Newsletters and Alerts

Morning Edition >> Afternoon Edition >> Breaking News

Enter your email address

Sign Up

James Cronin

Staff Reporter
Portland Business Journal



Metro will need to find a new facility to process hundreds of thousands of tons of reclaimed wood each year.

The local governing body sends the bulk of greater Portland's salvaged timber to a Newberg paper mill to burn as biomass. Now, with [news of the facility's pending closure](#), officials are scrambling to find alternatives.

BUSINESS PULSE

Charlie Hales makes \$133K per year. Is that the right compensation for Portland's mayor?

RELATED CONTENT

Newberg paper mill to close, lay off 171

HOME OF THE DAY



Tartan Druim at Tetherow

[See All Homes of the Day...](#)



With a Newberg paper mill closing, Metro officials will need to find a new place to send... [more](#)

PAULLETHOHN

Metro is working with DEQ and local facilities, as well as its own two solid waste transfer stations, to address the changes caused by the closure, slated for Nov. 15, which will also leave 171 workers jobless. That paper mill processed roughly 88 percent of the reclaimed wood from the greater Portland area, which it burned in its boilers to create steam and electricity and power the mill. Last year, it received about 127,000 tons of wood.



NARA