University of Minnesota Duluth
School of Business and Economics
Bureau of Business and Economic Research
Research Report

Forestry Bottleneck Analysis

SUMMARY and TECHNICAL REPORT

September 2002

Minnesota Forest Resources Council

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http://www.d.umn.edu/sbe/departments/bber/

Minnesota Forest Resources Council

UMD DULUTH BUREAU OF BUSINESS AND ECONOMIC RESEARCH

About the project

The Minnesota Sustainable Forest Resources Act of 1995 calls for long-term planning for forest sustainability in the state. Sustainability must consider social, ecological and economic factors. The research charge, for the UMD SBE Bureau of Business and Economic Research (BBER) as follows below, was to model the economic impacts to the current economy of northern MN when the wood supply changes in volume and species mix due to ecological considerations.

This project analyzed possible bottlenecks to wood products production when the supply of appropriate species of trees are not available. Most impact analyses using a model termed input-output analysis assume that, when one industry in a defined region increases its production, the necessary supply of intermediate products needed in production will be available. This assumption implies that local resources are currently underutilized or that excess capacity exists in the supplying industries.

If resources are fully utilized, then expansion is not possible without an increase in imported intermediate goods.. What is more, if intermediate resource supply currently being produced in the region declines, the current rate of production in the resource using industries can not be sustained, absent the imported intermediate goods.

This project analyzed various scenarios to determine the impact from changing forest species mixes on the paper industry as well as on other wood product industries.

The BBER worked closely with the Forestry Resources Council and others to determine the key assumptions for development of the IMPLAN model.

What this report does not cover:

- We did not look at alternatives relative to land use, e.g., tourism vs. other commercial uses of the forest.
- We did not look at the benefits and costs of alternative land uses.
- We are did not estimate tree supply – this is being provided by the Council.
- We did not look at social/environmental impacts.
- Although we report bottlenecks for the combined region, we did not report specific IMPLAN impacts for the regions combined, because for this model the impacts of the two regions do not equal the impact of a combined region.
- We did not estimate wood imports and exports separately. IMPLAN estimates imports and exports and these values were used as part of the model.

Contract end date: August 25, 2002.

Executive Summary

Project purpose

The UMD Bureau of Business and Economic Research (BBER) was asked to analyze possible bottlenecks to wood products production when the supply of appropriate species of trees are not available, and to develop a new input-output hybrid model that combines physical quantities with monetary quantities. BBER was also asked to make scenario runs based on suggestions from the Minnesota Forest Resources Council (MFRC).

The project deliverable is to produce a detailed report showing where there are impacts from supply bottlenecks to production based on the changes in wood supply and species mix due to ecological considerations.

Source Data and Methodology

The study areas for the report were defined as the Northeast Minnesota Region (Carlton, Cook, Lake and St. Louis counties) and the North Central Minnesota Region (Aitkin, Becker, Beltrami, Cass, Clearwater, Crow, Hubbard, Itasca, and Mahnomen counties).

Applying bottleneck analysis to NE MN forest products industries requires information on the capacity of regional forests to supply the needs of using industries. Ideally, these limits would be by tree species as utilized by different industries If the capacities are not known, assumed scenarios could be hypothesized to test the sensitivity of different industries to resource constraints.

BBER was given model-building inputs (harvest volume in cords, for tree species, for regions, for scenarios) from the Regional Committees of the MFRC for five hypothetical scenarios. With these inputs, the BBER used the economic modeling software and data system known as IMPLAN, MS Access and MS Excel to create a hybrid input-output model that would show bottlenecks in supply given changes in demand.

BBER was also asked to do sensitivity analyses for current (1999) data, for one percent increase and decrease, and for ten percent increase and decrease in final demand for Pulp and Paper.

Findings

Findings in this report for the two regions and five scenarios are organized in two groups:
1) Supply and Demand Bottleneck findings for three industries (Pulp and Paper Reconstituted Wood Products - RWP, Sawmills, and Specialty Woods) and Sensitivity Analysis (current, one percent increase/decrease, and ten percent increase/decrease in Pulp and Paper); 2) Impacts of the supply bottlenecks derived from IMPLAN (employment, value added, and output).

Supply and Demand Bottleneck findings

Supply and Demand Bottleneck findings for three industries (Pulp and Paper RWP, Sawmills, and Specialty Woods) include the following calculation: volume of tree species calibrated through model demand coefficients report the difference between supply and demand as the so-called "bottlenecks" when negative values are reported. This report contains tables for identifying these bottlenecks for the Northeast and North Central regions; for Pulp and Paper RWP, Sawmills, Specialty Woods; for the current (1999) year and for five hypothetical "scenarios" (variously constituted multi-tree species harvest). Positive numbers indicate "potential" growth in the industry. In other words there is sufficient supply so that if new demand or markets could be found, additional expansion could occur.

For example, in the Northeast Region, for the baseline (1999) year,[1] supply presents bottlenecks to output generation of industry products for most tree species at volumes presented in scenario one, fewer bottlenecks in scenario two, still fewer in scenarios three and none in scenario four and five. (Figure 1 shows bottlenecks –negative values- as grey cells in the table.) Note: Note: Specialty Woods impact numbers are very small. The details are shown in the data Appendix.

Northeast Minnesota: Pulp and Paper, Sawmills Bottleneck Supply and Demand

			Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
	Tree Species	DEMAND for all scenarios	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand
Pulp & Paper	Balsam Fir	72259	67627	(4632)	76448	4189	98010	25751	212682	140423	328334	256075
	White Birch	73846	127057	53211	140867	67021	128898	55052	176774	102928	224651	150805
	Maple	4927	10890	5963	15840	10913	55440	50513	57420	52493	59400	54473
	Aspen	549756	320493	(229263)	353816	(195940)	462607	(87149)	612563	62807	762518	212762
	Mixed Hardwoods	13297	12355	(942)	18058	4761	127354	114057	149213	135916	171072	157775
	Red Pine	17572	19325	1753	21740	4168	45896	28324	45896	28324	46500	28928
	White Pine	1812	594	(1218)	594	(1218)	15444	13632	16335	14523	17226	15414
	Jack Pine	33535	21899	(11636)	24245	(9290)	16424	(17111)	33630	95	51619	18084
	Mixed Softwoods	74776	31690	(43086)	37452	(37324)	283289	208513	342827	268051	404286	329510
	TOTAL	841779	611930	(229849)	689060	(152719)	1233362	391583	1647340	805561	2065606	1223827
Sawmills	Balsam Fir	2489	683	(1806)	772	(1717)	990	(1499)	2148	(341)	3317	828
	White Birch	3867	9563	5697	10603	6736	9702	5835	13306	9439	16909	13043
	Maple	156	0	(156)	0	(156)	0	(156)	0	(156)	0	(156)
	Aspen	18935	3237	(15697)	3574	(15361)	4673	(14262)	6188	(12747)	7702	(11232)
	Mixed Hardwoods	574	515	(59)	752	179	5306	4733	6217	5644	7128	6554
	Red Pine	3298	11722	8423	13187	9889	27839	24541	27839	24541	28205	24907
	White Pine	1013	1386	373	1386	373	36036	35023	38115	37102	40194	39181
	Jack Pine	3471	5821	2350	6445	2974	4366	895	8940	5469	13721	10251
	Mixed Softwoods	3006	980	(2025)	1158	(1847)	8762	5756	10603	7597	12504	9498
	TOTAL	36808	33908	(2900)	37877	1070	97673	60866	113355	76547	129680	92872

Figure 1: Northeast Minnesota: Pulp and Paper, and Sawmills; Bottleneck Supply and Demand Source: MFRC, IMPLAN, BBER

[1] IMPLAN data for 1999 is the most current data available and represents the current or baseline data for this report.

North Central Minnesota: Pulp and Paper, Sawmills Bottleneck Supply and Demand

	Tree Species	DEMAND for all scenarios	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand	Supply	Supply Minus Demand
Pulp & Paper	Balsam Fir	65,559	63,063	(2,496)	65,003	(556)	78,586	13,027	140,679	75,120	202,772	137,213
	White Birch	81,402	78,062	(3,340)	79,943	(1,459)	134,492	53,090	186,219	104,817	237,006	155,604
	Maple	519	505	(14)	505	(14)	38,877	38,358	40,897	40,378	42,917	42,398
	Aspen	1,042,053	775,544	(266,509)	943,046	(99,007)	742,625	(299,428)	744,561	(297,492)	1,234,481	192,428
	Mixed Hardwoods	26,380	25,502	(878)	25,502	(878)	234,986	208,606	281,437	255,057	328,799	302,419
	Red Pine	44,280	43,065	(1,215)	40,590	(3,690)	89,100	44,820	90,090	45,810	91,575	47,295
	White Pine	908	792	(116)	792	(116)	4,950	4,042	5,148	4,240	5,445	4,537
	Jack Pine	63,375	66,429	3,054	63,162	(213)	50,094	(13,281)	51,183	(12,192)	87,665	24,290
	Mixed Softwoods	41,048	41,293	245	41,293	245	177,656	136,608	217,988	176,940	257,360	216,312
	TOTAL	1,365,524	1,094,255	(271,269)	1,259,836	(105,688)	1,551,366	185,842	1,758,202	392,678	2,488,020	1,122,496
Sawmills	Balsam Fir	5,853	1,287	(4,566)	1,327	5,893	1,604	(4,249)	2,871	(2,982)	4,138	(1,715)
	White Birch	7,849	4,109	(3,740)	4,208	7,948	7,079	(770)	9,801	1,952	12,474	4,625
	Maple	151	485	334	485	151	37,353	37,202	39,293	39,142	41,234	41,083
	Aspen	93,172	15,860	(77,312)	19,285	96,597	15,187	(77,985)	15,226	(77,946)	25,245	(67,927)
	Mixed Hardwoods	8,834	29,938	21,103	29,938	8,834	275,854	267,019	330,383	321,549	385,981	377,147
	Red Pine	11,786	37,036	25,250	34,907	9,657	76,626	64,840	77,477	65,692	78,755	66,969
	White Pine	1,452	7,128	5,676	7,128	1,452	44,550	43,098	46,332	44,880	49,005	47,553
	Jack Pine	16,287	53,143	36,856	50,530	13,673	40,075	23,788	40,946	24,659	70,132	53,845
	Mixed Softwoods	3,761	1,277	(2,484)	1,277	3,761	5,495	1,734	6,742	2,981	7,960	4,199
	TOTAL	149,144	150,262	1,118	149,084	147,966	503,821	354,677	569,072	419,928	674,923	525,779

Figure 2: North Central Minnesota: Pulp and Paper, and Sawmills; Bottleneck, Supply and Demand Source: MFRC, IMPLAN, BBER

Findings for the North Central Region are similar to the Northeast in that bottlenecks occur primarily in Scenarios 1 and 2 for the Pulp and Paper and the Sawmills section. The North Central Region also shows bottlenecks for balsam, fir, and aspen in Scenario 3-5.

Sensitivity Analysis

Sensitivity tests contribute to the discussion on tree species mix and wood supply. Scenario 2, given the assumptions for Scenario 2 from the MFRC[2], might be considered as closest to "where we are now" and using this scenario to test for sensitivity could show interesting changes in tree mix. Negative supply numbers show bottlenecking species in the mix. See report for complete sensitivity analyses: Baseline, 10% Decrease, 10% Increase, 1% Decrease, 1% Increase

The example graph which follows shows only Sensitivity Analysis for Northeast Pulp and Paper RWP, Scenario 2

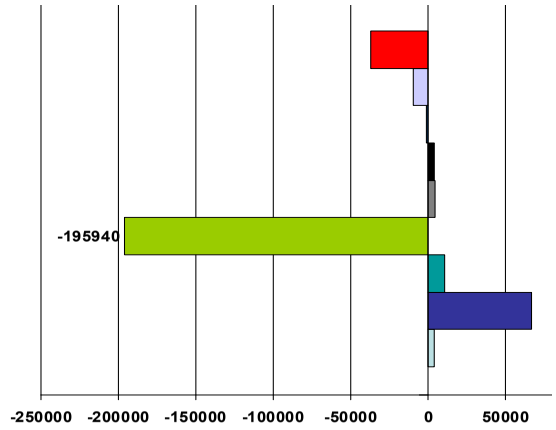
The greatest cord volume change is in aspen which moved according to the specific demand change. For example, a 10% decrease in demand causes the bottleneck in Scenario 2 to swell to –250,916 from the baseline –195,940. Likewise, a 10% decrease causes the aspen bottleneck to drop to –140,961 from –195,940.

[2] Scenario 2 – This scenario increases harvest volumes over scenario 1 by increasing even-age management in the mesic and dry mesic pine and the northern hardwood-conifer plant communities. These increased harvest levels can be maintained over a 10-20 year period and still move the landscape toward min RNV. Source: MFRC

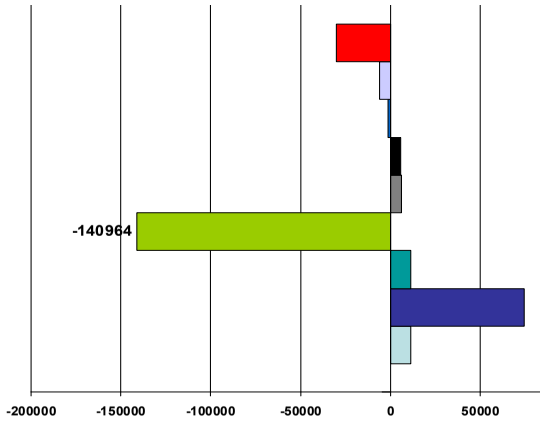
Northeast Pulp and Paper, Scenario 2

Negative supply numbers show bottlenecking species in the mix.

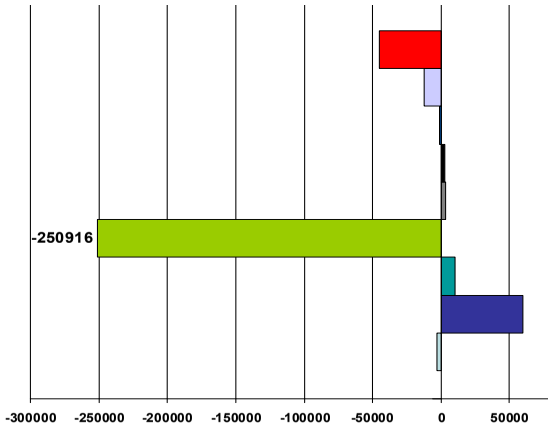
Scenario 2 — Baseline



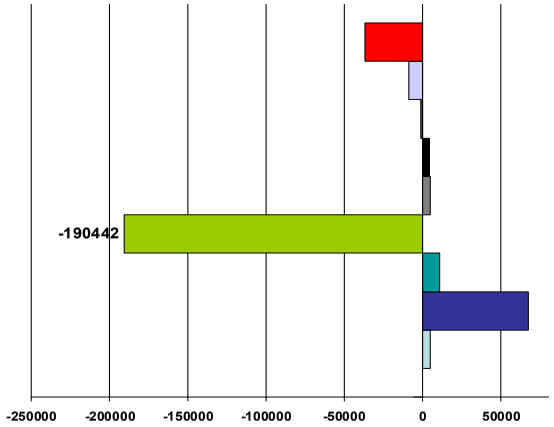
Scenario 2 — 10% Decrease



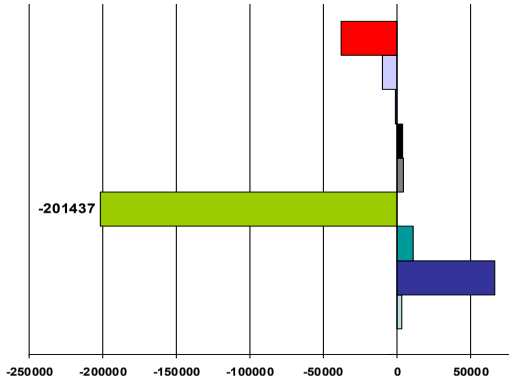
Scenario 2 — 10% Increase



Scenario 2 — 1% Decrease



Scenario 2 — 1% Increase



Tree Species Key

- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir

Impacts of the supply bottlenecks

To determine the three impacts the dollar value of final demand is calculated based on the supply of wood available in each scenario. The calculated final demand is then compared to the 1999 final demand. The difference between the two final demands is the input for IMPLAN and the results are reported as employment value added and output impacts.

Impacts of the supply bottlenecks derived from IMPLAN (employment, value added, and output) are shown in the report as specific impacts on specific industries. Percent calculations show changes in the degree of impact for the Sector and for the Region.

The following three pages highlight the employment, value added, and output direct and indirect impacts. Each region is broken down into the three industry sectors.

For each industry sector, that sector's employment is shown along with total regional employment. The direct impact is compared as a percentage to that sector's employment. For example, in the Northeast Region Pulp and Paper, Scenario 2, direct employment loss is -345 jobs, or -16.9 percent of Northeast Region Pulp and Paper employment of 2,039 jobs. As a comparison to total regional employment, that indirect impact employment loss in Scenario 2 is -652 jobs or 0.4 percent of the total regional employment of 144,685. The same percentages are calculated for value added and output on the other tables.

Employment Impacts from IMPLAN
Northeast and North Central Region

	Change in Direct Employment	*% change Sector*	*Change in Indirect Employment*	*% change Region*
Northeast Region				
Pulp & Paper RWP Impact	*Total Sector*		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*2,039*	*Employment =*	*144,895*
Scenario 1	-520	-25.5%	-981	-0.7%
Scenario 2	-345	-16.9%	-652	-0.4%
Scenario 3	885	43.4%	1670	1.2%
Scenario 4	1822	89.3%	3436	2.4%
Scenario 5	2767	135.7%	5220	3.6%
Sawmills Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*517*	*Employment =*	*144,895*
Scenario 1	-9	-1.7%	-10	0.0%
Scenario 2	3	0.6%	4	0.0%
Scenario 3	187	36.1%	208	0.1%
Scenario 4	235	45.4%	261	0.2%
Scenario 5	285	55.1%	317	0.2%
Specialty Woods Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*573*	*Employment =*	*144,895*
Scenario 1	60	10.4%	35	0.0%
Scenario 2	107	18.7%	63	0.0%
Scenario 3	583	101.8%	344	0.2%
Scenario 4	583	101.8%	344	0.2%
Scenario 5	595	103.8%	350	0.2%
North Central Region				
Pulp & Paper RWP Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*2,449*	*Employment =*	*132,416*
Scenario 1	-463	-18.9%	-981	-0.7%
Scenario 2	-180	-7.3%	352	0.3%
Scenario 3	317	12.9%	619	0.5%
Scenario 4	670	27.4%	1309	1.0%
Scenario 5	1915	78.2%	3740	2.8%
Sawmills Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*389*	*Employment =*	*132,416*
Scenario 1	0	0.1%	1	0.0%
Scenario 2	0	0.0%	0	0.0%
Scenario 3	118	30.3%	221	0.2%
Scenario 4	140	35.9%	262	0.2%
Scenario 5	175	44.9%	328	0.2%
Specialty Woods Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Employment =*	*1,139*	*Employment =*	*132,416*
Scenario 1	-13	-1.1%	-10	0.0%
Scenario 2	-20	-1.7%	-14	0.0%
Scenario 3	638	56.0%	466	0.4%
Scenario 4	656	57.6%	479	0.4%
Scenario 5	856	75.2%	626	0.5%

Source: IMPLAN, BBER, MFRC

Value Added Impacts from IMPLAN
Northeast and North Central Region

	Change in Value Added	*% change Sector*	*Change in Indirect Value Added*	*% change Region*
Northeast Region				
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*$215.9 million*	*Total Region Value Added =*	*$6,285.7 million*
Scenario 1	-$55	-25.5%	-$42	-0.7%
Scenario 2	-$37	-17.0%	-$28	-0.4%
Scenario 3	$94	43.4%	$72	1.1%
Scenario 4	$193	89.3%	$147	2.3%
Scenario 5	$293	135.7%	$224	3.6%
Sawmills Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*$20.2 million*	*Total Region Value Added =*	*$6,285.7 million*
Scenario 1	-$0.35	-1.7%	-$0.40	0.0%
Scenario 2	-$0.13	-0.6%	-$0.15	0.0%
Scenario 3	$7.30	36.1%	$8.30	0.1%
Scenario 4	$9.20	45.5%	$10.40	0.2%
Scenario 5	$11.10	55.0%	$12.70	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*$21.8 million*	*Total Region Value Added =*	*$6,285.7 million*
Scenario 1	$2.30	0.4%	$1.50	0.0%
Scenario 2	$4.10	0.7%	$2.60	0.0%
Scenario 3	$22.20	3.9%	$14.30	0.2%
Scenario 4	$20.20	3.5%	$14.30	0.2%
Scenario 5	$22.60	3.9%	$54.30	0.9%
North Central Region				
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*258.5 million*	*Total Region Value Added =*	*$5,003.4 million*
Scenario 1	-$49	-18.9%	-$34	-0.7%
Scenario 2	-$19	-7.3%	-$13	-0.3%
Scenario 3	$34	12.9%	$23	0.5%
Scenario 4	$71	27.3%	$49	1.0%
Scenario 5	$202	78.1%	$141	2.8%
Sawmills Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*12.4 million*	*Total Region Value Added =*	*$5,003.4 million*
Scenario 1	$0.01	0.1%	$0.02	0.0%
Scenario 2	$0.00	0.0%	$0.00	0.0%
Scenario 3	$3.70	29.8%	$7.50	0.1%
Scenario 4	$4.40	35.5%	$8.90	0.2%
Scenario 5	$5.50	44.4%	$11.10	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	*Total Sector Value Added =*	*45.1 million*	*Total Region Value Added =*	*$5,003.4 million*
Scenario 1	$2.30	5.1%	$1.50	0.0%
Scenario 2	$4.10	9.1%	$2.60	0.1%
Scenario 3	$22.20	49.2%	$14.30	0.3%
Scenario 4	$20.20	44.8%	$14.30	0.3%
Scenario 5	$22.60	50.1%	$54.30	1.1%

Source: IMPLAN, BBER, MFRC

Output Impacts from IMPLAN
Northeast and North Central Region

	Change in Output	*% change Sector*	*Change in Indirect Output*	*% change Region*
Northeast Region				
Pulp & Paper RWP Impact	*Total Sector*		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$592.1 million*	*Output =*	*$11,140.8 million*
Scenario 1	-$151	-25.5%	-$72	-0.6%
Scenario 2	-$100	-16.9%	-$48	-0.4%
Scenario 3	$257	43.4%	$122	1.1%
Scenario 4	$529	89.3%	$252	2.3%
Scenario 5	$804	135.7%	$382	3.4%
Sawmills Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$64.1 million*	*Output =*	*$11,140.8 million*
Scenario 1	-$1.10	-1.7%	-$0.70	0.0%
Scenario 2	$0.41	0.6%	$0.26	0.0%
Scenario 3	$23.20	36.2%	$14.60	0.1%
Scenario 4	$29.10	45.4%	$18.40	0.2%
Scenario 5	$35.30	55.1%	$22.30	0.2%
Specialty Woods Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$52.4 million*	*Output =*	*$11,140.8 million*
Scenario 1	$5.40	10.3%	$2.80	0.0%
Scenario 2	$9.80	18.7%	$5.00	0.0%
Scenario 3	$53.30	101.7%	$27.10	0.2%
Scenario 4	$53.30	101.7%	$27.10	0.2%
Scenario 5	$54.30	103.6%	$27.60	0.2%
North Central Region				
Pulp & Paper RWP Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$710.3 million*	*Output =*	*$8,995 million*
Scenario 1	-$134	-18.9%	-$59	-0.7%
Scenario 2	-$52	-7.4%	-$23	-0.3%
Scenario 3	$92	12.9%	$41	0.5%
Scenario 4	$194	27.4%	$86	1.0%
Scenario 5	$555	78.2%	$245	2.7%
Sawmills Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$60.4 million*	*Output =*	*$8,995 million*
Scenario 1	$0.06	0.1%	$0.05	0.0%
Scenario 2	$0.00	0.0%	$0.00	0.0%
Scenario 3	$18.30	30.3%	$14.20	0.2%
Scenario 4	$21.70	35.9%	$16.80	0.2%
Scenario 5	$27.10	44.9%	$21.10	0.2%
Specialty Woods Impact				
	Total Sector		*Total Region*	
Note: Compare % relative to these totals:	*Output =*	*$121.6 million*	*Output =*	*$8,995 million*
Scenario 1	-$1.40	-1.2%	-$0.70	0.0%
Scenario 2	-$2.10	-1.7%	-$1.10	0.0%
Scenario 3	$68.20	56.1%	$33.70	0.4%
Scenario 4	$70.00	57.6%	$34.60	0.4%
Scenario 5	$91.40	75.2%	$45.20	0.5%

Source: IMPLAN, BBER, MFRC

What does this means for policy makers?

How good are these numbers? Note that our analyses are reported here in some cases as *potentia*l impacts.

Other mitigating factors might be:

- It is important to note that supply does not create demand without proper pricing, and in this case such pricing could be seen as significant price cuts.
- It is important to remember that there have to be markets for these industries to supply in order for the analyses in this report to deliver as expected.
- It is important to note that transportation costs play a major role in the "big picture," especially when shipping is not transacted by weight (per/lb. for instance) but per unit value (for instance shipping costs for furniture from the Specialty Woods sector).

What this report does not cover:

- We did not look at alternatives relative to land use, e.g., tourism vs. other commercial uses of the forest.
- We did not look at the benefits and costs of alternative land uses.
- We are did not estimate tree supply – this is being provided by the Council.
- We did not look at social/environmental impacts.
- Although we report bottlenecks for the combined region, we did not report specific IMPLAN impacts for the regions combined, because for this model the impacts of the two regions do not equal the impact of a combined region.

The Import/Export picture:

- Exports are a part of final demand
- Imports are a part of final payments
- Final payments affect size of multipliers
- Final demand does not
- Pulp and paper, sawmills, and miscellaneous take exports and imports into account
- Logging does not (physical units)
- It can if data are available

But importantly, with this bottleneck analysis project completed, we now have a model to use for more applications and more scenarios. This model has the flexibility to look at a variety of possible scenarios and changing wood supplies. From the model, we have a range of numbers for the big picture discussion and long-term planning. It's important to note the precision of these estimates is unknown. Any statistical error could arise from both the demand (IMPLAN) or the wood supply estimates (Regional Landscape Committees) that may affect the final results.

The information is based on 1999 data, technology, and productivity. Technology and productivity have improved since 1999. But the exact changes needed for this analysis are not known and changing values would only be guesses in this limited study.

But even if the bottleneck and impact numbers are not completely accurate to the penny, the relative magnitude and direction of the changes are reasonable and valuable. These estimates still provide the best estimates for policymakers based on the best data that is available. These numbers confirm that for long-term planning, GEIS analysis can be used to shape the landscape, when planning includes consequences from the large impact that forest products have on the economy of the region and the state.

Table of Contents

Tables

Introduction

Input-output analysis, when combined with data from outside the I/O system, has the capability of analyzing bottlenecks when capacity limitations are known. Generally, the input-output system is used to calculate equilibrium output levels given a region's industrial/production structure. When computing impacts from a particular industry whose output is predicted to increase, the usual assumption is that supplying industries can increase their scale of production to accommodate these intermediate product needs. In other words, full employment is assumed in the supplying industries.

This assumption is subject to instability of supply in the forest products industry. For example, capacity to provide raw material to paper plants or other users of tree inputs often changes in response to political activity, government rules and regulations and state and federal legislation. Other assumptions that may be transgressed might include: 1) If resources are not fully employed, then the hypothesized increase in activity will not increase in capacity; 2) If intermediate resources are not available, higher resource prices can be the only result; and 3) If there is not intermediate capacity, bottlenecks appear, limiting economic growth in resource using industries, absent import increases.

To analyze this situation, economists begin by estimating the supply needs of hypothesized buyers of intermediate production. We then hypothesize changes in the output of these purchasing industries which, in turn, increase the outputs of supplying industries. It is important to note that all measures are in terms of dollars of output and not physical output units. Input-output looks at the ways all industries in a region interact through purchases from and sales to one another. This means all industries are tied together in terms of resource availability. Therefore, constraints against any single industry exert impacts on all other regional industries.

Applying bottleneck analysis to Northeast Minnesota's forest products industries requires information on the capacity of regional forests to supply the needs of using industries. Ideally, these limits would be by tree species as utilized by different industries (paper, particle board, furniture production, etc). These capacities would serve as a potential constraint to the region's output. If the capacities are not known, assumed scenarios could be hypothesized to test the sensitivity of different industries to resource constraints.

There are many variations of bottleneck analyses possible. For example, the system could be formed into a constrained maximization model. Such a model might assume that the region wants to maximize industrial output. If resource supply is inadequate to allow full production of all resource using industries, linear programming could be used to choose only those industries that maximize output. Or, the resource could be allocated to various industries in proportion to their ability to supply output. Another possibility relates to restrictions on forest outputs: Assumed restrictions could be imposed on the model to estimate the actual economic impact from constrained resources. Again, maximization models could be employed to allocate, to industries, the resources that remain, with efficiency as the goal.

DESCRIPTION OF THE WORK

The MN Sustainable Forest Resources Act of 1995 calls for long-term planning for forest sustainability in the state. Sustainability must consider social, ecological and economic factors. The research charge, for the UMD SBE Bureau of Business and Economic Research (BBER) as follows below, is to model the economic impacts to the current economy of northern MN when the wood supply changes in volume and species mix due to ecological considerations.

The BBER's project will analyze possible bottlenecks to wood products production when the supply of appropriate species of trees are not available.

If resources are fully utilized, then expansion is not possible without increase in intermediate capacity. What is more, if intermediate resource supply currently being produced in the region declines, the current rate of production in the resource using industries can not be sustained.

This project will analyze various scenarios, both long term (15 years) and short term (emphasizing sheltered harvesting) scenarios to determine the impact from changing forest species mixes on the paper industry as well as on other wood product industries.

DELIVERABLES

1. A detailed report showing where there are impacts from supply bottlenecks to production based on the changes in wood supply and species mix due to ecological considerations.

2. PowerPoint presentations of the results will be developed for presentations before the various components of the MN Sustainable Resource Council.

Data and Methods

Study Areas:

Northeast Minnesota
North Central Minnesota

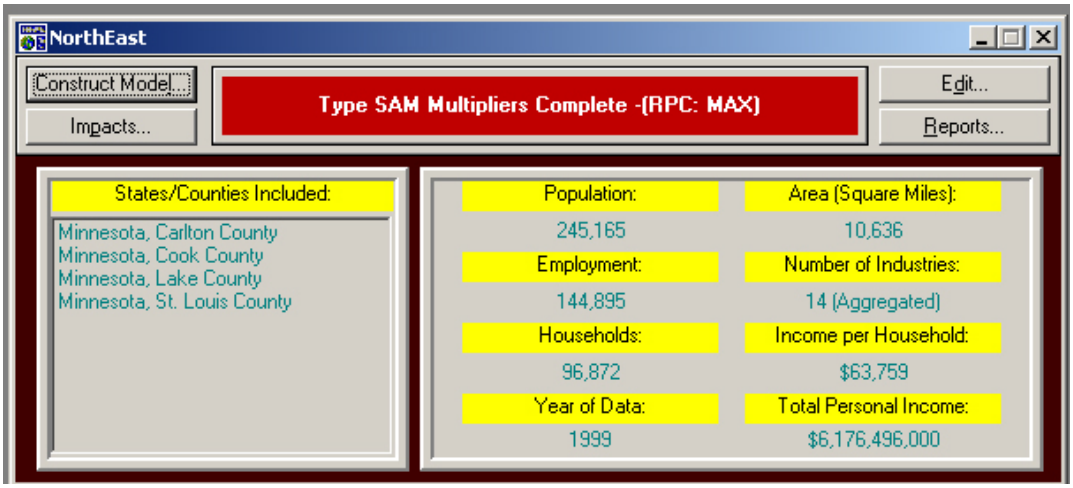


Figure 3: Counties and General Model Description of IMPLAN data for Northeast Minnesota Study Area

Source: screen capture from IMPLAN software, version 2.0 copyright MIG 1997-1999.

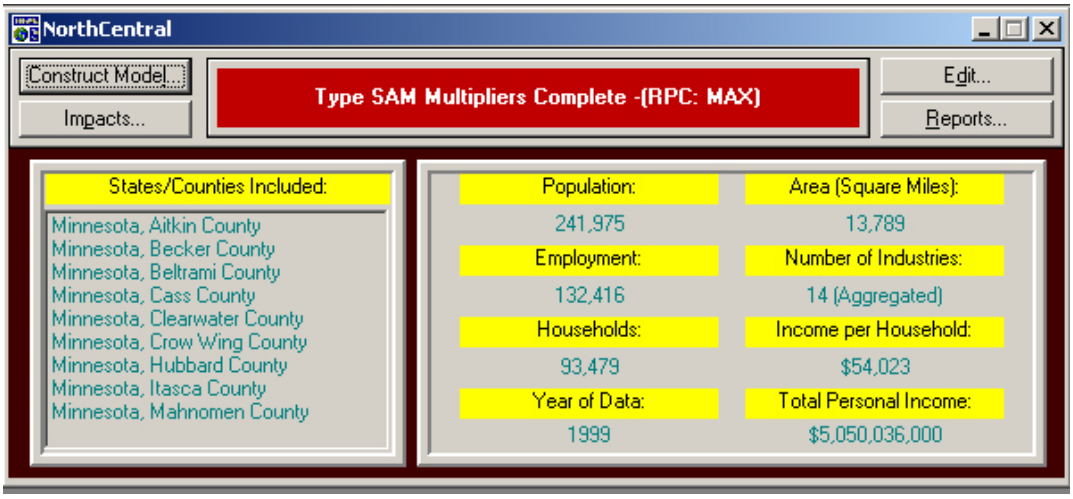


Figure 4: Counties and General Model Description of IMPLAN data for North Central Minnesota Study Area

Source: screen capture from IMPLAN software, version 2.0 copyright MIG 1997-1999.

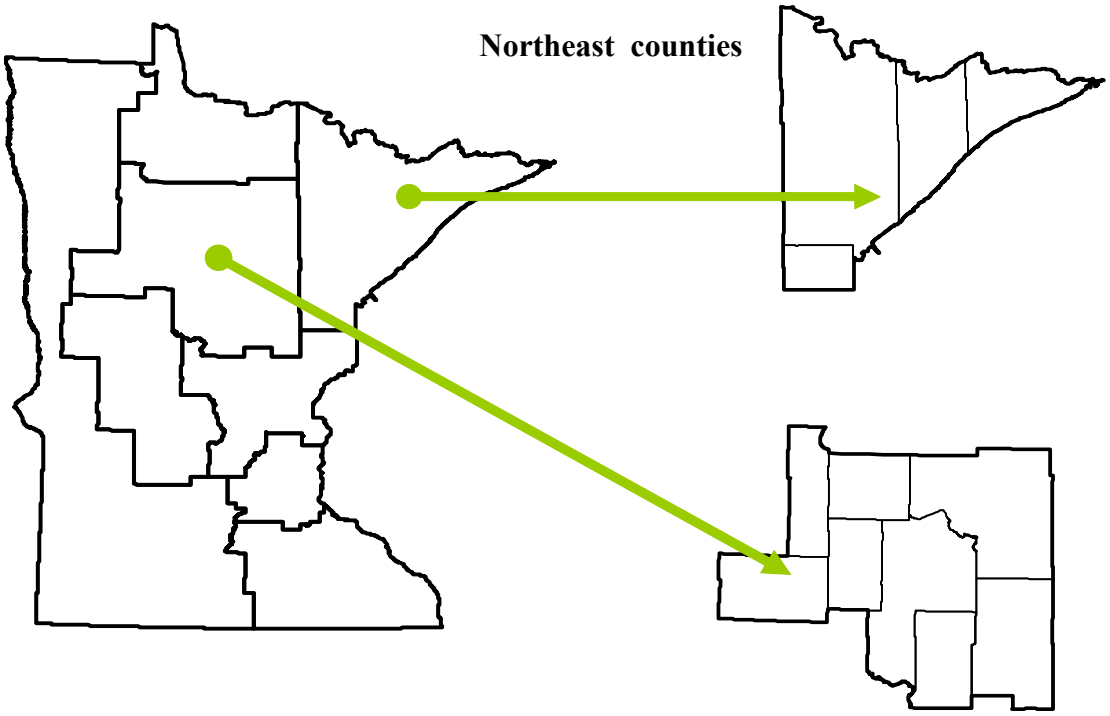


Figure 5: Study Areas - Northeast counties and North Central counties

Source: Chad Skally, GIS Apps / Forest Planner, Landscape Program, NRRI

Northeast Minnesota Region
Carlton
Cook
Lake
St. Louis

North Central Minnesota Region
Aitkin
Becker
Beltrami
Cass,
Clearwater,
Crow,
Hubbard
Itasca
Mahnomen

Input-output Analysis

The impact estimates utilize a large-scale mathematical model commonly termed input-output, as well as a software/data system for input-output table estimations, known as IMPLAN. A brief introduction to each of these models follows.

Input-output was developed by Wassily Leontief in the 1930s. It was utilized during World War II to identify potential bottlenecks to expanding wartime production and to identify German industries for bombing. For his efforts, Leontief won the first ever-awarded Nobel Prize for economics.

Input-output is a mathematical model that tracks the purchases and sales of intermediate products from one local producer to other local producers. *Intermediate products* are goods and services needed as inputs in order for a local firm to produce its output. The assumption is that the purchasing firm ***requires*** the intermediate products it purchases from other firms in order to produce its own output. Thus, if the output of the purchasing firm expands, its need for intermediate products also expands Supplying firms then increase their outputs and purchase their needed intermediate products from one another. This results in rounds of purchases and sales rippling through the region, leading to indirect impacts.

Definitions of Direct and Indirect Impacts

Direct	The dollar value of output or the employment that can actually be attributed to the home region (the region being analyzed). This output (or employment) is usually associated with the activities of a particular industry.
Indirect	The impact from the primary industry's purchases of intermediate goods and services from other local industries. These secondary industries also purchase from and sell to one another, creating rounds of impact activity.

A *multiplier* represents the number of additional dollars, employment, or value added that are created when a dollar, an employee, a unit of value added is added or subtracted from a region's industries. The multiplier summarizes the rounds of spending described above. The multiplier also applies when a new production operation enters a region or an existing operation leaves the region. A brief, but more complete description of the input-output system appears in Appendix A.

Employment, as the name implies, is the number of part and full time employees employed by the industry. V*alue Added* represents local earnings from various industry productions. Technically, it is sum of employee compensation and property income. *Property Income* is the returns to property, including rent, interest and profits. *Industry Output* represents the sum of intermediate sales to other regional firms plus sales to Final Demand. *Final Demand* represents the sales to final users of the product — users that will not use the good or service for

further production. Final demand consists of local household consumption, business investment in physical capital, changes in business inventories, federal, state and local government purchases of goods and services, and exports outside of the region (not necessarily to foreign economies). The multiplier process is triggered by initial industry sales to final demand.

The reason that the purchases and sales eventually work themselves out is that all intermediate inputs are not purchased locally. Imported goods and services plus the components of value added, represent leakages from the spending/purchasing stream, reducing the size of the ultimate multiplier.

The input-output model does not actually look at individual firms. It collects firms into industry categories that contain similar, but not identical products. Thus, we have industry categories such as Electric Utilities, Lumber and Wood Products, Sawmills, and, in IMPLAN, 525 others. The assumption is that it is meaningful to categorize firms in this manner. A second assumption is that prices are constant. We handle this assumption in this analysis by reducing all future industry monetary transactions into 1999 prices (i.e., by taking anticipated inflation out of consideration).

Input-output is a production model. *This means that only the production that takes place in the region is counted*. Purchases from other regions do not count. For example, if an automobile is purchased in Grand Rapids for $20,000, how much of that $20,000 is local? The car was produced somewhere else, Detroit, Japan, Germany, or wherever. We have to deduct the production that is imported from our impacts in order to get a true reading on what happened locally. Only the local margin is counted as local. If the margin is 10%, then only $2,000 of the total sale is said to be local. Using a production model also means that output figures are double counted (intermediate plus final goods and services). Therefore, note that Value added is closer to the Gross Domestic Product approach to production accounting.

Employment data comes from government sources, specifically, ES202 files from the U.S. Department of Labor. These files estimate all employment in a region that is taxed for Social Security. To the government, an employee is an employee. In other words, employment is not stated in terms of full time equivalents. A part time employee is counted as an employee on the same basis as a full time employee is counted. This means that employment in sectors such as retail trade, which hires many part time workers, will report higher employment totals than would be the case if full time equivalent employment was estimated.

Finally, and very importantly, estimated impacts assume that the region being studied is operating at full capacity. This means that an increase in activity by one industry requires additional resources, such as employees, in other industries. If there is excess capacity, the employment and value added impacts would be lower than estimated in this report. To find capacity levels for all industries in a region would require a survey, which is well beyond the budget allocated for this analysis. Therefore, we are following the direction taken by most studies of this type, assuming full capacity utilization in our analysis

IMPLAN

There are two ways to create an input-output model for any region. The first is to collect primary information from local firms by asking for a detailed breakdown of their intermediate good or service purchases as well as of their intermediate sales. Primary information concerning sales to final demand and purchases from value added would also have to be provided. This process is generally too expensive to accomplish and can be very expensive to keep current.

The second way is to use *secondary information* (or information already collected, usually for another purpose) to construct a regional input-output system. The secondary data approach is usually accomplished by adjusting the national input-output system to reflect local production. The adjustment for this analysis is accomplished by a software system called IMPLAN. The U.S. Forest Service, in its impact assessments, funded the creation of IMPLAN, initially developed at Colorado State University. The model was refined at the University of Minnesota, St. Paul, and is now maintained in a private enterprise firm, IMPLAN Users Group. This firm also creates and sells the initial data bases for use in the package. IMPLAN provides the user with many options for estimating impacts resulting from changes in a defined regional economy. IMPLAN breaks down the national system into state systems and then breaks the resulting state systems into counties. Our assessment utilizes the IMPLAN software and the 1999 database, the most recent available, to carry out its purpose.

Forecasting model

The basis for the forecasting model is that of input-output analysis. We used the software system, IMPLAN, to identify dollar transactions. We then exported dollar transactions to Excel and developed a model including industry interactions with physical cords of tree species.

The model development occurs in a series of steps. As shown in Figure 4, the IMPLAN model uses purchases and sales to determine the Northeast and North Central regions. The model then was aggregated into 14 sectors which generated the dollar values for the direct and indirect affects of the input-output analysis. The hybrid input-output model was created by adding the tree species cord data to the spreadsheets and the model results were generated.

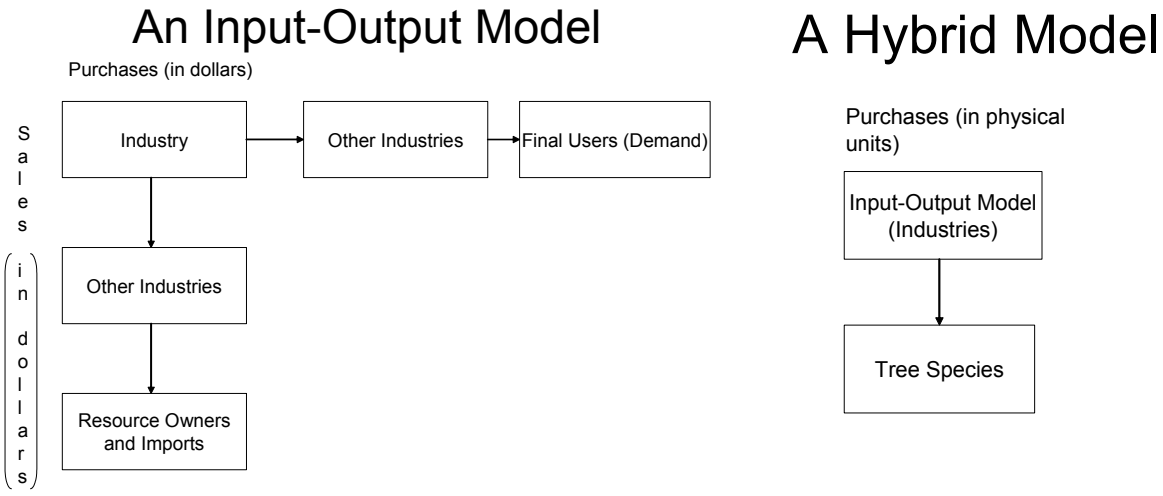


Figure 6: Input-output model to hybrid input-output model for forestry bottleneck analysis

Source: Richard Lichty, UMD SBE Bureau of Business and Economic Research.

Scenarios

The Northeast and North Central Landscape Committees agreed to several scenarios at their June 2002 meetings. Each scenario represents a set of ecological and/or economic conditions in the landscape that will be analyzed to determine economic impacts. Current harvest volumes are the average harvest from 1997-1999 and will be used as the baseline for analysis. Once the analysis is complete the committees in each landscape region will determine what set of landscape goals and strategies will be used to reach desired conditions.

Following are the descriptions of each scenario for each region and the regions combined as well as the harvest volumes based on each scenario:

NORTHEAST REGION

Scenario 1 – This scenario was developed by small ad hoc groups utilizing successional models with the goal of moving the landscape to min RNV in a 100 yr time frame.
Scenario 2 – This scenario increases harvest volumes over scenario 1 by increasing even-age management in the mesic and dry mesic pine and the northern hardwood-conifer plant communities. These increased harvest levels can be maintained over a 10-20 year period and still move the landscape toward min RNV. (Range of Natural Variation)
Scenario 3 –This scenario is total growth minus mortality based on 1990 FIA (Forest Inventory and Analysis National Program, USFS) data.

Scenario 4 – This scenario is total growth minus 50% of the mortality based on 1990 FIA data. It assumes that 50% of total mortality is captured through harvesting.
Scenario 5 - This includes all annual growth for all species; it assumes that all mortality is captured and utilized for products.

Table 1: Northeast cord volumes for scenarios

Tree Species Groups	Current 1999	*Scenario 1*	Scenario 2	*Scenario 3*	*Scenario 4*	*Scenario 5*
Balsam Fir	74,000	69,000	78,000	100,000	217,000	335,000
White Birch	80,000	138,000	153,000	140,000	192,000	244,000
Maple	5,000	11,000	16,000	56,000	58,000	60,000
Aspen	563,000	327,000	361,000	472,000	625,000	778,000
Mixed Hardwoods*	14,000	13,000	19,000	134,000	157,000	180,000
Red Pine	27,000	32,000	36,000	76,000	76,000	77,000
White Pine	5,000	2,000	2,000	52,000	55,000	58,000
Jack Pine	42,000	28,000	31,000	21,000	43,000	66,000
Mixed Softwoods**	78,000	33,000	39,000	295,000	357,000	421,000
Total	888,000	653,000	735,000	1,346,000	1,780,000	2,219,000

Source: Scenarios 1 and 2: research from the UMN, NRRI, and landscape committees; Scenarios 3, 4, and 5: 1990 FIA data (using a conversion factor of 75 cuft per cord).
* Mixed hardwoods include: White and red oak; soft maple; yellow birch; basswood and other
** Mixed softwood includes: White and black spruce; tamarack; cedar and other

NORTH CENTRAL REGION

Scenario 1: This scenario moves to min RNV over 100 yrs. It was used in place of the scenario the Skally group developed because they were so similar.
Scenario 2: This scenario was developed by the Adams small group and moves the landscape toward RNV over a longer timeframe.
Scenario 3: This is total growth minus mortality using 1990 FIA data.
Scenario 4: This scenario is total growth minus 50% of the mortality based on 1990 FIA data. It assumes that 50% of total mortality is captured through harvesting.
Scenario 5: This includes all annual growth for all species; it assumes that all mortality is captured and utilized for products.

Table 2: North Central cord volumes for scenarios

Tree Species Groups	Current 1999	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Scenario 5
Balsam Fir	68,000	65,000	67,000	81,000	145,000	209,000
White Birch	87,000	83,000	85,000	143,000	198,000	252,000
Maple	1,000	1,000	1,000	77,000	81,000	85,000
Aspen	1,082,000	801,000	974,000	767,000	769,000	1,275,000
Mixed Hardwoods	56,000	56,000	56,000	516,000	618,000	722,000
Red Pine	82,000	87,000	82,000	180,000	182,000	185,000
White Pine	7,000	8,000	8,000	50,000	52,000	55,000
Jack Pine	113,000	122,000	116,000	92,000	94,000	161,000
Mixed Softwoods	43,000	43,000	43,000	185,000	227,000	268,000
Total	1,539,000	1,266,000	1,432,000	2,091,000	2,366,000	3,212,000

Source: Scenarios 1 and 2: research from the UMN, NRRI, and landscape committees; Scenarios 3, 4, and 5: 1990 FIA data (using a conversion factor of 75 cuft per cord).

* Mixed hardwoods include: White and red oak; soft maple; yellow birch; basswood and other

** Mixed softwood includes: White and black spruce; tamarack; cedar and other

COMBINED REGIONS

Scenarios represent combined numbers for the NE and NC regions.

Table 3: Cord volumes for combined regions' scenarios

Tree Species Groups	Current 1999	*Scenario 1*	Scenario 2	*Scenario 3*	*Scenario 4*	*Scenario 5*
Balsam Fir	142,000	134,000	145,000	181,000	362,000	544,000
White Birch	167,000	221,000	238,000	283,000	390,000	496,000
Maple	7,000	12,000	17,000	133,000	139,000	145,000
Aspen	1,645,000	1,128,000	1,335,000	1,239,000	1,394,000	2,053,000
Mixed Hardwoods	70,000	69,000	75,000	650,000	775,000	902,000
Red Pine	109,000	119,000	118,000	256,000	258,000	262,000
White Pine	11,000	10,000	10,000	102,000	107,000	113,000
Jack Pine	155,000	150,000	147,000	113,000	137,000	227,000
Mixed Softwoods	121,000	76,000	82,000	480,000	584,000	689,000
Total	2,427,000	1,919,000	2,167,000	3,437,000	4,146,000	5,431,000

Source: Scenarios 1 and 2: research from the UMN, NRRI, and landscape committees; Scenarios 3, 4, and 5: 1990 FIA data (using a conversion factor of 75 cuft per cord).

* Mixed hardwoods include: White and red oak; soft maple; yellow birch; basswood and other

** Mixed softwood includes: White and black spruce; tamarack; cedar and other

Findings

Bottleneck findings (Supply and Demand)

Input Output Analysis: Bottleneck Analysis Procedure

Readers who are interested in the specifics of the methodology are invited to examine an example procedure below. Solutions to special challenges presented in this project include the conversion of the input-output model to a hybrid model, the software programming to accomplish this, the implementation of tree species instead of generic cords of wood as variables, as well as special adjustments to the mathematical model. The procedure may be summed up by the following steps: first, data for inputs from cord volumes are gathered; second, adjusted cords from the percent that goes into each respective industry are calculated; third, based on the cord/percentage calculations, calculations for supply minus demand are accomplished. This procedure is shown below.

Input for production model

Input for production model for the MFRC Northeast landscape region (in cords) used to calculate percentage final demand for the industry sectors of sawmill, specialty and pulp.

Table 4: Example: NE Scenario 1% input for production model

NorthEast Scenario 1				
1999 cords and percentages; source: MFRC				
Species	*cords*	*Saw mill*	*Speci ality*	*Pulp*
Balsam Fir	69000	1%	0%	99%
White Birch	138000	7%	0%	93%
Maple	11000	0%	0%	100%
Aspen	327000	1%	0%	99%
Mixed Hard	13000	4%	0%	96%
Red Pine	32000	37%	2%	61%
White Pine	2000	70%	0%	30%
Jack Pine	28000	21%	0%	79%
Mixed Soft	33000	3%	0%	97%
Total	653000			

Source: MFRC

Data on wood supply, BBER creates cords and percentages

Data on wood supply, BBER creates cords and percentages from inputs For example, in the Northeast, using the 1999 baseline, for the first scenario of tree species mix, the following cord numbers were provided:

Table 5: Example: NE Scenario 1, cords from inputs

Cords				
Species	**Sawmill**	**Specialty**	**Pulp**	**Total**
Balsam Fir	683	0	67,627	68,310
White Birch	9,563	0	127,057	136,620
Maple	0	0	10,890	10,890
Aspen	3,237	0	320,493	323,730
Mixed Hardwoods	515	0	12,355	12,870
Red Pine	11,722	633.6	19,325	31,680
White Pine	1,386	0	594	1,980
Jack Pine	5,821	0	21,899	27,720
Mixed Softwoods	980	0	31,690	32,670
Total	33,908	634	**611,929**	646,470

Source: BBER

Bottleneck configured

For example, supply minus demand for the Northeast, in tree mix scenario 1, shows demand exceeding supply in many cases, as follows:

Figure 7: Example: NE Scenario 1, bottleneck supply minus demand*

NE Pulp and Paper Total Cords, Scenario 1

	Demand	*Supply*	*Supply minus demand*
Balsam Fir	72259	67,627	(4632)
White Birch	73846	127,057	53211
Maple	4927	10,890	5963
Aspen	549756	320,493	(229263)
Mixed Hard	13297	12,355	(942)
Red Pine	17572	19,325	1753
White Pine	1812	594	(1218)
Jack Pine	33535	21,899	(11636)
Mixed Soft	74776	31,690	(43086)
TOTAL	841779	**611,930**	(229849)

Source: BBER, MFRC*Note: from the total cord value we subtracted out the tree species final demand.

Baseline Table and Graphs

Table 10 shows difference in supply and demand. Note negative numbers in parentheses as supply"bottlenecks**."** For each scenario, the 1999 demand is held constant and supply is changed to determine each bottleneck.

Similar tables will also be shown for displaying bottlenecks in the Northeast , North Central, and Combined Regions for Pulp and Paper RWP, Sawmills, and Specialty Woods, for 1% increase and decrease, and for 10% increase and decrease under the topic, Sensitivity Analyses, following the baseline table and graph.

Note that in the following graphs, some values are very small or minimal which make some distinctions difficult to appreciate graphically. Please see tables for clarification of these small values.

Table 6: NE, NC and Combined Regions, Pulp and Paper Sector, 1999 Bottleneck situations as negative numbers

	NE Pulp and Paper	1999												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$552,800,000												
Balsam Fir	0.000130714	72,259	72,527	268	67,627	(4,632)	76,448	4,189	98,010	25,751	212,682	140,423	328,334	256,075
White Birch	0.000133585	73,846	73,656	(190)	127,057	53,211	140,867	67,021	128,898	55,052	176,774	102,928	224,651	150,805
Maple	8.9126E-06	4,927	4,950	23	10,890	5,963	15,840	10,913	55,440	50,513	57,420	52,493	59,400	54,473
Aspen	0.000994493	549,756	551,796	2,040	320,493	(229,263)	353,816	(195,940)	462,607	(87,149)	612,563	62,807	762,518	212,762
Mixed Hardwoods	2.40542E-05	13,297	13,306	9	12,355	(942)	18,058	4,761	127,354	114,057	149,213	135,916	171,072	157,775
Red Pine	3.17872E-05	17,572	16,305	(1,267)	19,325	1,753	21,740	4,168	45,896	28,324	45,896	28,324	46,500	28,928
White Pine	3.27699E-06	1,812	1,485	(327)	594	(1,218)	594	(1,218)	15,444	13,632	16,335	14,523	17,226	15,414
Jack Pine	6.06638E-05	33,535	32,848	(687)	21,899	(11,636)	24,245	(9,290)	16,424	(17,111)	33,630	95	51,619	18,084
Mixed Softwoods	0.000135268	74,776	74,903	127	31,690	(43,086)	37,452	(37,324)	283,289	208,513	342,827	268,051	404,286	329,510
TOTAL	0.001522755	841,779	841,776	(3)	611,930	(229,849)	689,060	(152,719)	1,233,362	391,583	1,647,340	805,561	2,065,606	1,223,827

	NC Pulp and Paper	1999												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$675,700,000												
Balsam Fir	9.70232E-05	65,559	65,974	415	63,063	(2,496)	65,003	(556)	78,586	13,027	140,679	75,120	202,772	137,213
White Birch	0.00012047	81,402	81,824	422	78,062	(3,340)	79,943	(1,459)	134,492	53,090	186,219	104,817	237,006	155,604
Maple	7.67473E-07	519	505	(14)	505	(14)	505	(14)	38,877	38,358	40,897	40,378	42,917	42,398
Aspen	0.001542183	1,042,053	1,047,614	5,561	775,544	(266,509)	943,046	(99,007)	742,625	(299,428)	744,561	(297,492)	1,234,481	192,428
Mixed Hardwoods	3.90412E-05	26,380	25,502	(878)	25,502	(878)	25,502	(878)	234,986	208,606	281,437	255,057	328,799	302,419
Red Pine	6.55318E-05	44,280	40,590	(3,690)	43,065	(1,215)	40,590	(3,690)	89,100	44,820	90,090	45,810	91,575	47,295
White Pine	1.34433E-06	908	693	(215)	792	(116)	792	(116)	4,950	4,042	5,148	4,240	5,445	4,537
Jack Pine	9.3792E-05	63,375	61,529	(1,846)	66,429	3,054	63,162	(213)	50,094	(13,281)	51,183	(12,192)	87,665	24,290
Mixed Softwoods	6.07493E-05	41,048	41,293	245	41,293	245	41,293	245	177,656	136,608	217,988	176,940	257,360	216,312
TOTAL	0.002020903	1,365,524	1,365,524	0	1,094,255	(271,269)	1,259,836	(105,688)	1,551,366	185,842	1,758,202	392,678	2,488,020	1,122,496

	Combined Pulp and Paper	1999												
	Total Cords													
			1999- Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$1,228,500,000												
Balsam Fir	0.000112169	137,800	138,501	701	130,690	(7,110)	141,451	3,651	176,596	38,796	353,361	215,561	531,105	393,305
White Birch	0.000126243	155,089	155,480	391	205,118	50,029	220,810	65,721	263,390	108,301	362,993	207,904	461,657	306,568
Maple	4.43521E-06	5,449	5,455	6	11,395	5,946	16,345	10,896	94,317	88,868	98,317	92,868	102,317	96,868
Aspen	0.001296504	1,592,756	1,599,410	6,654	1,096,037	(496,719)	1,296,862	(295,894)	1,205,232	(387,524)	1,357,124	(235,632)	1,996,998	404,242
Mixed Hardwoods	3.27143E-05	40,190	38,808	(1,382)	37,858	(2,332)	43,560	3,370	362,340	322,150	430,650	390,460	499,871	459,681
Red Pine	5.10012E-05	62,655	56,895	(5,760)	62,390	(265)	62,330	(325)	134,996	72,341	135,986	73,331	138,075	75,420
White Pine	2.17917E-06	2,677	2,178	(499)	1,386	(1,291)	1,386	(1,291)	20,394	17,717	21,483	18,806	22,671	19,994
Jack Pine	7.94085E-05	97,553	94,377	(3,176)	88,328	(9,225)	87,407	(10,146)	66,518	(31,035)	84,813	(12,740)	139,283	41,730
Mixed Softwoods	9.41842E-05	115,705	116,196	491	72,983	(42,722)	78,745	(36,960)	460,944	345,239	560,815	445,110	661,647	545,942
TOTAL	0.001798839	2,209,874	2,207,300	(2,574)	1,706,185	(503,689)	1,948,896	(260,978)	2,784,727	574,853	3,405,542	1,195,668	4,553,624	2,343,750

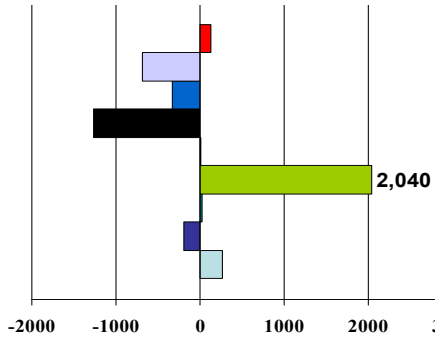
Source: IMPLAN, BBER, MFRC

Northeastern Pulp and Paper

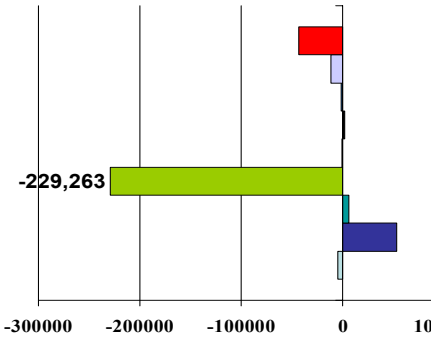
Species Mix Scenarios Showing Supply Bottlenecks- Baseline

Negative supply numbers show bottleneck species in the mix.

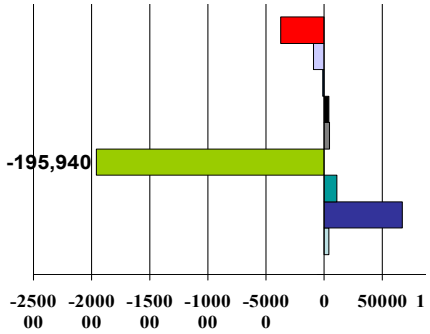
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



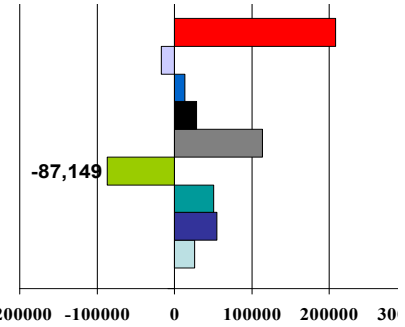
Current-1999



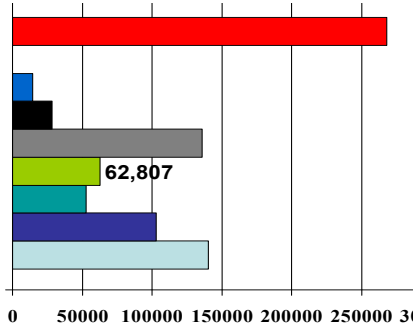
Scenario 1



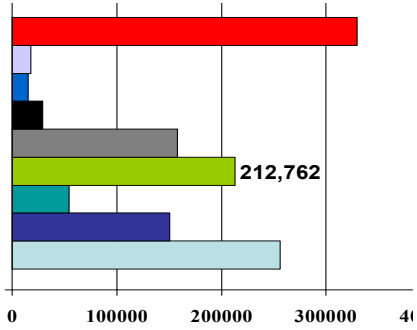
Scenario 2



Scenario 3



Scenario 4



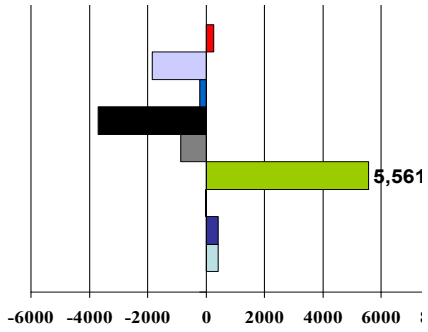
Scenario 5

North Central Pulp and Paper

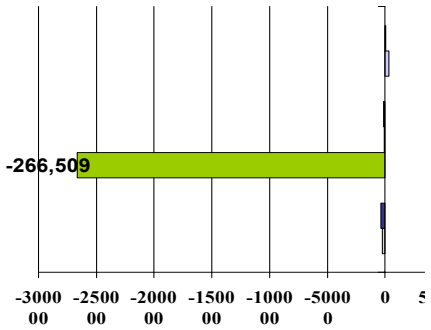
Species Mix Scenarios Showing Supply Bottlenecks- Baseline

Negative supply numbers show bottleneck species in the mix.

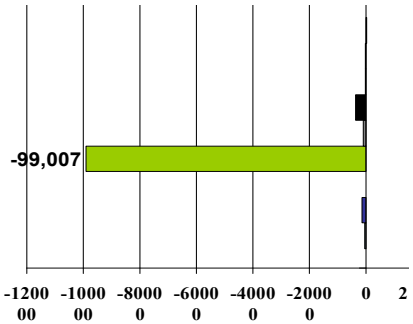
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



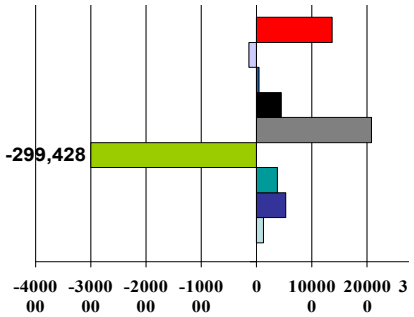
Current-1999



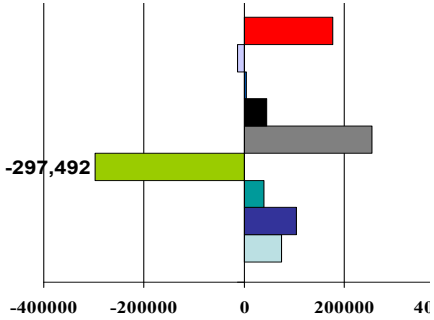
Scenario 1



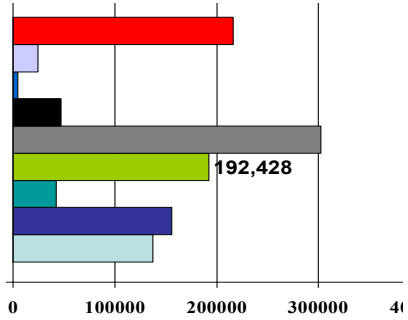
Scenario 2



Scenario 3



Scenario 4



Scenario 5

Sensitivity Analyses

In the tables and graphs which follow, sensitivity tests for Northeast and North Central 1% Decrease, 1% Increase , 10% Decrease, 10% Increase, are shown. Sensitivity tests contribute to the discussion on tree species mix and wood supply. Negative supply numbers show bottlenecking species in the mix.

The greatest cord volume change is in aspen which moved according to the specific demand change. For example, a 10% decrease in demand causes the bottleneck in Northeast Scenario 2 to swell to –250,916 from the baseline –195,940. Likewise, a 10% decrease causes the aspen bottleneck to drop to –140,961 from –195,940.

Table 7: NE, NC and Combined Regions, Pulp and Paper Sector, 1% decrease from 1999, Bottlenecks as negative numbers

	NE Pulp and Paper	1% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$547,272,000												
Balsam Fir	0.000130714	71,536	72,527	991	67,627	(3,909)	76,448	4,912	98,010	26,474	212,682	141,146	328,334	256,798
White Birch	0.000133585	73,107	73,656	549	127,057	53,950	140,867	67,760	128,898	55,791	176,774	103,667	224,651	151,544
Maple	8.9126E-06	4,878	4,950	72	10,890	6,012	15,840	10,962	55,440	50,562	57,420	52,542	59,400	54,522
Aspen	0.000994493	544,258	551,796	7,538	320,493	(223,765)	353,816	(190,442)	462,607	(81,651)	612,563	68,305	762,518	218,260
Mixed Hardwoods	2.40542E-05	13,164	13,306	142	12,355	(809)	18,058	4,894	127,354	114,190	149,213	136,049	171,072	157,908
Red Pine	3.17872E-05	17,396	16,305	(1,091)	19,325	1,929	21,740	4,344	45,896	28,500	45,896	28,500	46,500	29,104
White Pine	3.27699E-06	1,793	1,485	(308)	594	(1,199)	594	(1,199)	15,444	13,651	16,335	14,542	17,226	15,433
Jack Pine	6.06638E-05	33,200	32,848	(352)	21,899	(11,301)	24,245	(8,955)	16,424	(16,776)	33,630	430	51,619	18,419
Mixed Softwoods	0.000135268	74,028	74,903	875	31,690	(42,338)	37,452	(36,576)	283,289	209,261	342,827	268,799	404,286	330,258
TOTAL	0.001522755	833,361	841,776	8,415	611,930	(221,431)	689,060	(144,301)	1,233,362	400,001	1,647,340	813,979	2,065,606	1,232,245
	NC Pulp and Paper	1% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$668,943,000												
Balsam Fir	9.70232E-05	64,903	65,974	1,071	63,063	(1,840)	65,003	100	78,586	13,683	140,679	75,776	202,772	137,869
White Birch	0.00012047	80,588	81,824	1,236	78,062	(2,526)	79,943	(645)	134,492	53,904	186,219	105,631	237,006	156,418
Maple	7.67473E-07	513	505	(8)	505	(8)	505	(8)	38,877	38,364	40,897	40,384	42,917	42,404
Aspen	0.001542183	1,031,632	1,047,614	15,982	775,544	(256,088)	943,046	(88,586)	742,625	(289,007)	744,561	(287,071)	1,234,481	202,849
Mixed Hardwoods	3.90412E-05	26,116	25,502	(614)	25,502	(614)	25,502	(614)	234,986	208,870	281,437	255,321	328,799	302,683
Red Pine	6.55318E-05	43,837	40,590	(3,247)	43,065	(772)	40,590	(3,247)	89,100	45,263	90,090	46,253	91,575	47,738
White Pine	1.34433E-06	899	693	(206)	792	(107)	792	(107)	4,950	4,051	5,148	4,249	5,445	4,546
Jack Pine	9.3792E-05	62,741	61,529	(1,212)	66,429	3,688	63,162	421	50,094	(12,647)	51,183	(11,558)	87,665	24,924
Mixed Softwoods	6.07493E-05	40,638	41,293	655	41,293	655	41,293	655	177,656	137,018	217,988	177,350	257,360	216,722
TOTAL	0.002020903	1,351,869	1,365,524	13,655	1,094,255	(257,614)	1,259,836	(92,033)	1,551,366	199,497	1,758,202	406,333	2,488,020	1,136,151
	Combined Pulp and Paper	1% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$1,216,215,000												
Balsam Fir	0.000112169	136,422	138,501	2,079	130,690	(5,732)	141,451	5,029	176,596	40,174	353,361	216,939	531,105	394,683
White Birch	0.000126243	153,539	155,480	1,941	205,118	51,579	220,810	67,271	263,390	109,851	362,993	209,454	461,657	308,118
Maple	4.43521E-06	5,394	5,455	61	11,395	6,001	16,345	10,951	94,317	88,923	98,317	92,923	102,317	96,923
Aspen	0.001296504	1,576,828	1,599,410	22,582	1,096,037	(480,791)	1,296,862	(279,966)	1,205,232	(371,596)	1,357,124	(219,704)	1,996,998	420,170
Mixed Hardwoods	3.27143E-05	39,788	38,808	(980)	37,858	(1,930)	43,560	3,772	362,340	322,552	430,650	390,862	499,871	460,083
Red Pine	5.10012E-05	62,028	56,895	(5,133)	62,390	362	62,330	302	134,996	72,968	135,986	73,958	138,075	76,047
White Pine	2.17917E-06	2,650	2,178	(472)	1,386	(1,264)	1,386	(1,264)	20,394	17,744	21,483	18,833	22,671	20,021
Jack Pine	7.94085E-05	96,578	94,377	(2,201)	88,328	(8,250)	87,407	(9,171)	66,518	(30,060)	84,813	(11,765)	139,283	42,705
Mixed Softwoods	9.41842E-05	114,548	116,196	1,648	72,983	(41,565)	78,745	(35,803)	460,944	346,396	560,815	446,267	661,647	547,099
TOTAL	0.001798839	2,187,775	2,207,300	19,525	1,706,185	(481,590)	1,948,896	(238,879)	2,784,727	596,952	3,405,542	1,217,767	4,553,624	2,365,849

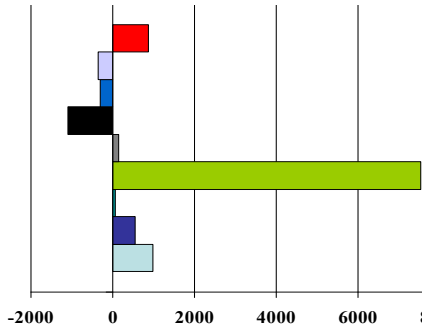
Source: IMPLAN, BBER, MFRC

Northeastern Pulp and Paper

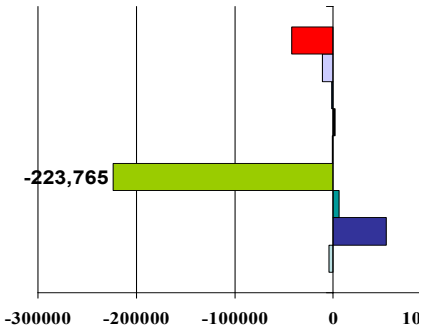
Species Mix Scenarios Showing Supply Bottlenecks- 1% Decrease

Negative supply numbers show bottleneck species in the mix.

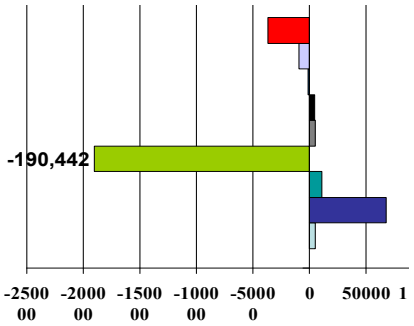
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



Current-1999



Scenario 1



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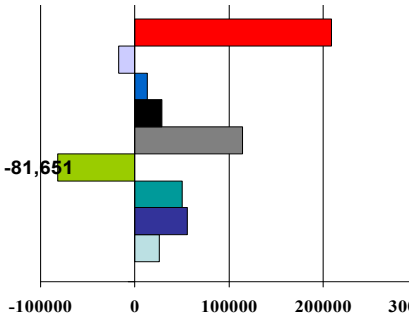

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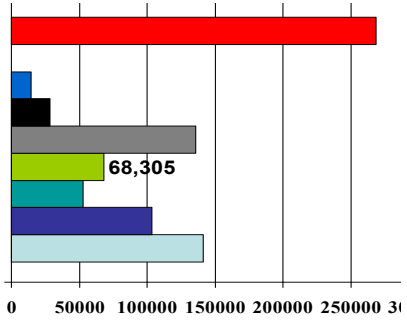
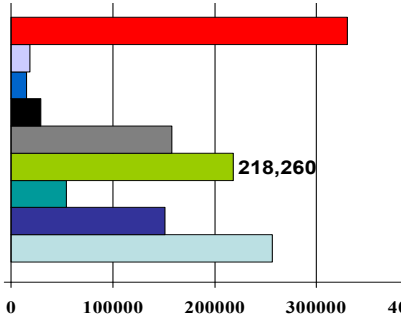


Scenario 4



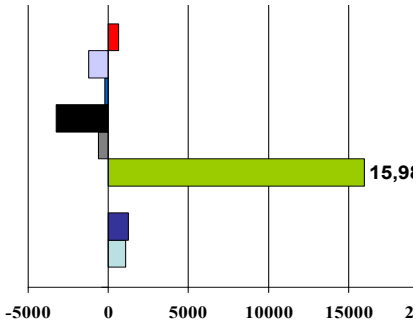
Scenario 5

North Central Pulp and Paper

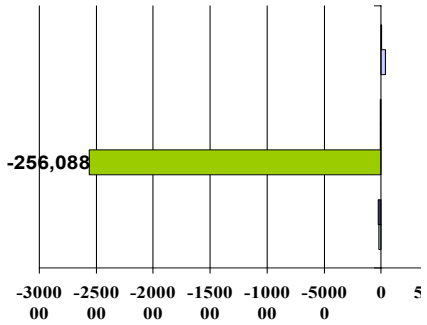
Species Mix Scenarios Showing Supply Bottlenecks- 1% Decrease

Negative supply numbers show bottleneck species in the mix.

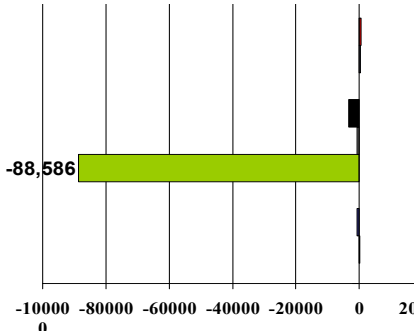
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



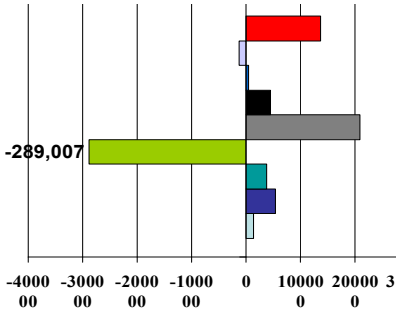
Current-1999



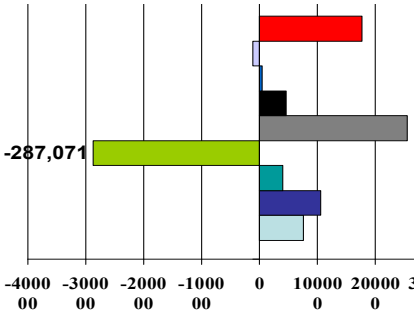
Scenario 1



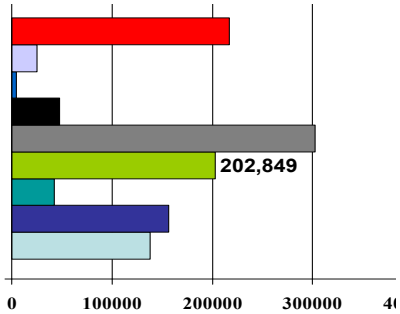
Scenario 2



Scenario 3



Scenario 4



Scenario 5

Table 8: NE, NC and Combined Regions, Pulp and Paper Sector, 1% increase from 1999, Bottlenecks as negative numbers

	NE Pulp and Paper	1% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	**Demand Coefficients**	**Demand**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**
		$558,328,000												
Balsam Fir	0.000130714	72,981	72,527	(454)	67,627	(5,354)	76,448	3,467	98,010	25,029	212,682	139,701	328,334	255,353
White Birch	0.000133585	74,584	73,656	(928)	127,057	52,473	140,867	66,283	128,898	54,314	176,774	102,190	224,651	150,067
Maple	8.9126E-06	4,976	4,950	(26)	10,890	5,914	15,840	10,864	55,440	50,464	57,420	52,444	59,400	54,424
Aspen	0.000994493	555,253	551,796	(3,457)	320,493	(234,760)	353,816	(201,437)	462,607	(92,646)	612,563	57,310	762,518	207,265
Mixed Hardwoods	2.40542E-05	13,430	13,306	(124)	12,355	(1,075)	18,058	4,628	127,354	113,924	149,213	135,783	171,072	157,642
Red Pine	3.17872E-05	17,748	16,305	(1,443)	19,325	1,577	21,740	3,992	45,896	28,148	45,896	28,148	46,500	28,752
White Pine	3.27699E-06	1,830	1,485	(345)	594	(1,236)	594	(1,236)	15,444	13,614	16,335	14,505	17,226	15,396
Jack Pine	6.06638E-05	33,870	32,848	(1,022)	21,899	(11,971)	24,245	(9,625)	16,424	(17,446)	33,630	(240)	51,619	17,749
Mixed Softwoods	0.000135268	75,524	74,903	(621)	31,690	(43,834)	37,452	(38,072)	283,289	207,765	342,827	267,303	404,286	328,762
TOTAL	0.001522755	850,197	841,776	(8,421)	611,930	(238,267)	689,060	(161,137)	1,233,362	383,165	1,647,340	797,143	2,065,606	1,215,409

	NC Pulp and Paper	1% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	**Demand Coefficients**	**Demand**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**
		$682,457,000												
Balsam Fir	9.70232E-05	66,214	65,974	(240)	63,063	(3,151)	65,003	(1,211)	78,586	12,372	140,679	74,465	202,772	136,558
White Birch	0.00012047	82,216	81,824	(392)	78,062	(4,154)	79,943	(2,273)	134,492	52,276	186,219	104,003	237,006	154,790
Maple	7.67473E-07	524	505	(19)	505	(19)	505	(19)	38,877	38,353	40,897	40,373	42,917	42,393
Aspen	0.001542183	1,052,473	1,047,614	(4,859)	775,544	(276,929)	943,046	(109,427)	742,625	(309,848)	744,561	(307,912)	1,234,481	182,008
Mixed Hardwoods	3.90412E-05	26,644	25,502	(1,142)	25,502	(1,142)	25,502	(1,142)	234,986	208,342	281,437	254,793	328,799	302,155
Red Pine	6.55318E-05	44,723	40,590	(4,133)	43,065	(1,658)	40,590	(4,133)	89,100	44,377	90,090	45,367	91,575	46,852
White Pine	1.34433E-06	917	693	(224)	792	(125)	792	(125)	4,950	4,033	5,148	4,231	5,445	4,528
Jack Pine	9.3792E-05	64,009	61,529	(2,480)	66,429	2,420	63,162	(847)	50,094	(13,915)	51,183	(12,826)	87,665	23,656
Mixed Softwoods	6.07493E-05	41,459	41,293	(166)	41,293	(166)	41,293	(166)	177,656	136,197	217,988	176,529	257,360	215,901
TOTAL	0.002020903	1,379,179	1,365,524	(13,655)	1,094,255	(284,924)	1,259,836	(119,343)	1,551,366	172,187	1,758,202	379,023	2,488,020	1,108,841

	Combined Pulp and Paper	1% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	**Demand Coefficients**	**Demand**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**	**Supply**	**Difference**
		$1,240,785,000												
Balsam Fir	0.000112169	139,178	138,501	(677)	130,690	(8,488)	141,451	2,273	176,596	37,418	353,361	214,183	531,105	391,927
White Birch	0.000126243	156,640	155,480	(1,160)	205,118	48,478	220,810	64,170	263,390	106,750	362,993	206,353	461,657	305,017
Maple	4.43521E-06	5,503	5,455	(48)	11,395	5,892	16,345	10,842	94,317	88,814	98,317	92,814	102,317	96,814
Aspen	0.001296504	1,608,683	1,599,410	(9,273)	1,096,037	(512,646)	1,296,862	(311,821)	1,205,232	(403,451)	1,357,124	(251,559)	1,996,998	388,315
Mixed Hardwoods	3.27143E-05	40,591	38,808	(1,783)	37,858	(2,733)	43,560	2,969	362,340	321,749	430,650	390,059	499,871	459,280
Red Pine	5.10012E-05	63,281	56,895	(6,386)	62,390	(891)	62,330	(951)	134,996	71,715	135,986	72,705	138,075	74,794
White Pine	2.17917E-06	2,704	2,178	(526)	1,386	(1,318)	1,386	(1,318)	20,394	17,690	21,483	18,779	22,671	19,967
Jack Pine	7.94085E-05	98,529	94,377	(4,152)	88,328	(10,201)	87,407	(11,122)	66,518	(32,011)	84,813	(13,716)	139,283	40,754
Mixed Softwoods	9.41842E-05	116,862	116,196	(666)	72,983	(43,879)	78,745	(38,117)	460,944	344,082	560,815	443,953	661,647	544,785
TOTAL	0.001798839	2,231,972	2,207,300	(24,672)	1,706,185	(525,787)	1,948,896	(283,076)	2,784,727	552,755	3,405,542	1,173,570	4,553,624	2,321,652

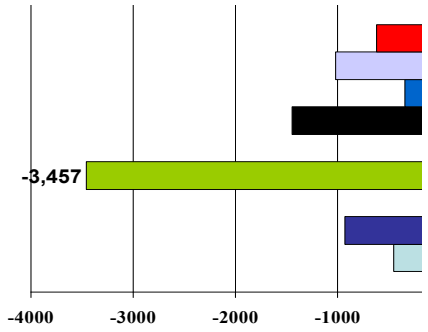
Source: IMPLAN, BBER, MFRC

Northeastern Pulp and Paper

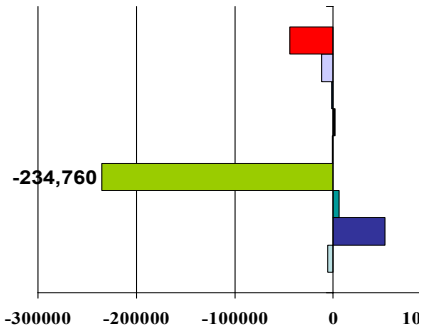
Species Mix Scenarios Showing Supply Bottlenecks- 1% Increase

Negative supply numbers show bottleneck species in the mix.

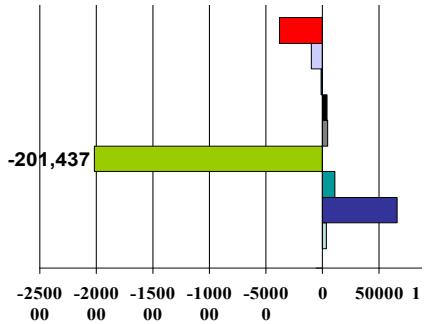
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



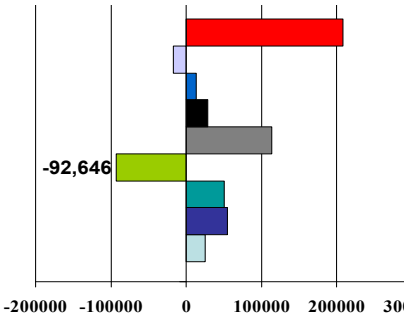
Current-1999



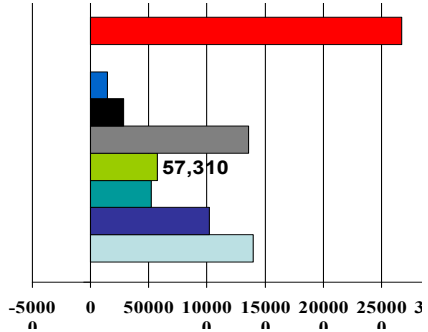
Scenario 1



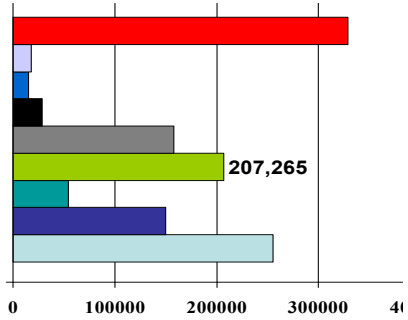
Scenario 2



Scenario 3



Scenario 4



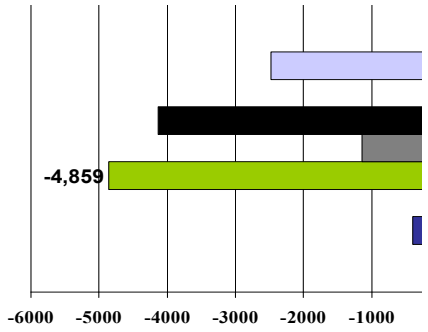
Scenario 5

North Central Pulp and Paper

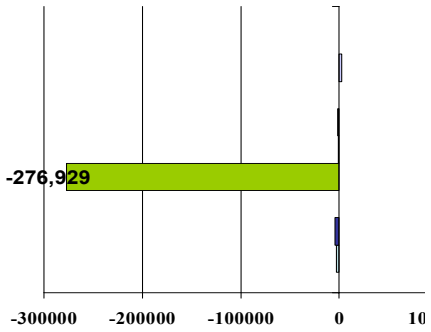
Species Mix Scenarios Showing Supply Bottlenecks- 1% Increase

Negative supply numbers show bottleneck species in the mix.

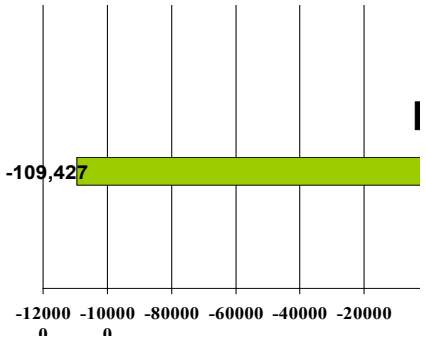
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



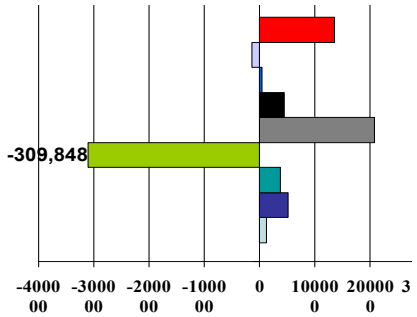
Current-1999



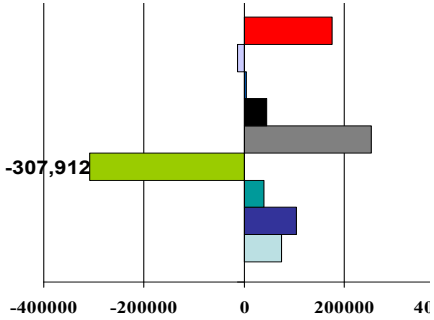
Scenario 1



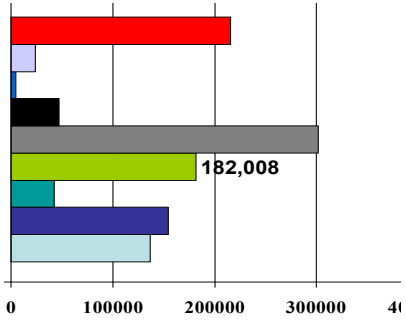
Scenario 2



Scenario 3



Scenario 4



Scenario 5

Table 9: NE, NC and Combined Regions, Pulp and Paper Sector, 10% decrease from 1999, Bottlenecks as negative numbers

	NE Pulp and Paper	10% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$497,520,000												
Balsam Fir	0.000130714	65,033	72,527	7,494	67,627	2,594	76,448	11,415	98,010	32,977	212,682	147,649	328,334	263,301
White Birch	0.000133585	66,461	73,656	7,195	127,057	60,596	140,867	74,406	128,898	62,437	176,774	110,313	224,651	158,190
Maple	8.9126E-06	4,434	4,950	516	10,890	6,456	15,840	11,406	55,440	51,006	57,420	52,986	59,400	54,966
Aspen	0.000994493	494,780	551,796	57,016	320,493	(174,287)	353,816	(140,964)	462,607	(32,173)	612,563	117,783	762,518	267,738
Mixed Hardwoods	2.40542E-05	11,967	13,306	1,339	12,355	388	18,058	6,091	127,354	115,387	149,213	137,246	171,072	159,105
Red Pine	3.17872E-05	15,815	16,305	490	19,325	3,510	21,740	5,925	45,896	30,081	45,896	30,081	46,500	30,685
White Pine	3.27699E-06	1,630	1,485	(145)	594	(1,036)	594	(1,036)	15,444	13,814	16,335	14,705	17,226	15,596
Jack Pine	6.06638E-05	30,181	32,848	2,667	21,899	(8,282)	24,245	(5,936)	16,424	(13,757)	33,630	3,449	51,619	21,438
Mixed Softwoods	0.000135268	67,299	74,903	7,604	31,690	(35,609)	37,452	(29,847)	283,289	215,990	342,827	275,528	404,286	336,987
TOTAL	0.001522755	757,601	841,776	84,175	611,930	(145,671)	689,060	(68,541)	1,233,362	475,761	1,647,340	889,739	2,065,606	1,308,005
	NC Pulp and Paper	10% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$608,130,000												
Balsam Fir	9.70232E-05	59,003	65,974	6,971	63,063	4,060	65,003	6,000	78,586	19,583	140,679	81,676	202,772	143,769
White Birch	0.00012047	73,262	81,824	8,562	78,062	4,800	79,943	6,681	134,492	61,230	186,219	112,957	237,006	163,744
Maple	7.67473E-07	467	505	38	505	38	505	38	38,877	38,410	40,897	40,430	42,917	42,450
Aspen	0.001542183	937,848	1,047,614	109,766	775,544	(162,304)	943,046	5,198	742,625	(195,223)	744,561	(193,287)	1,234,481	296,633
Mixed Hardwoods	3.90412E-05	23,742	25,502	1,760	25,502	1,760	25,502	1,760	234,986	211,244	281,437	257,695	328,799	305,057
Red Pine	6.55318E-05	39,852	40,590	738	43,065	3,213	40,590	738	89,100	49,248	90,090	50,238	91,575	51,723
White Pine	1.34433E-06	818	693	(125)	792	(26)	792	(26)	4,950	4,132	5,148	4,330	5,445	4,627
Jack Pine	9.3792E-05	57,038	61,529	4,491	66,429	9,391	63,162	6,124	50,094	(6,944)	51,183	(5,855)	87,665	30,627
Mixed Softwoods	6.07493E-05	36,943	41,293	4,350	41,293	4,350	41,293	4,350	177,656	140,713	217,988	181,045	257,360	220,417
TOTAL	0.002020903	1,228,971	1,365,524	136,553	1,094,255	(134,716)	1,259,836	30,865	1,551,366	322,395	1,758,202	529,231	2,488,020	1,259,049
	Combined Pulp and Paper	10% Decrease												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$1,105,650,000												
Balsam Fir	0.000112169	124,020	138,501	14,481	130,690	6,670	141,451	17,431	176,596	52,576	353,361	229,341	531,105	407,085
White Birch	0.000126243	139,581	155,480	15,899	205,118	65,537	220,810	81,229	263,390	123,809	362,993	223,412	461,657	322,076
Maple	4.43521E-06	4,904	5,455	551	11,395	6,491	16,345	11,441	94,317	89,413	98,317	93,413	102,317	97,413
Aspen	0.001296504	1,433,480	1,599,410	165,930	1,096,037	(337,443)	1,296,862	(136,618)	1,205,232	(228,248)	1,357,124	(76,356)	1,996,998	563,518
Mixed Hardwoods	3.27143E-05	36,171	38,808	2,637	37,858	1,687	43,560	7,389	362,340	326,169	430,650	394,479	499,871	463,700
Red Pine	5.10012E-05	56,389	56,895	506	62,390	6,001	62,330	5,941	134,996	78,607	135,986	79,597	138,075	81,686
White Pine	2.17917E-06	2,409	2,178	(231)	1,386	(1,023)	1,386	(1,023)	20,394	17,985	21,483	19,074	22,671	20,262
Jack Pine	7.94085E-05	87,798	94,377	6,579	88,328	530	87,407	(391)	66,518	(21,280)	84,813	(2,985)	139,283	51,485
Mixed Softwoods	9.41842E-05	104,135	116,196	12,061	72,983	(31,152)	78,745	(25,390)	460,944	356,809	560,815	456,680	661,647	557,512
TOTAL	0.001798839	1,988,886	2,207,300	218,414	1,706,185	(282,701)	1,948,896	(39,990)	2,784,727	795,841	3,405,542	1,416,656	4,553,624	2,564,738

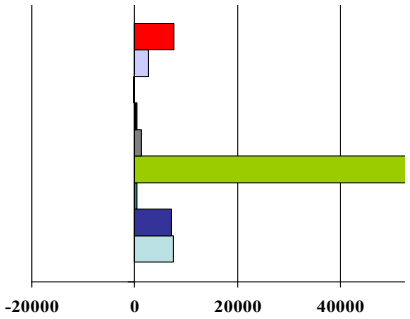
Source: IMPLAN, BBER, MFRC

Northeastern Pulp and Paper

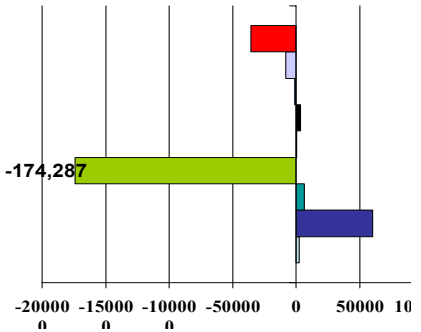
Species Mix Scenarios Showing Supply Bottlenecks- 10% Decrease

Negative supply numbers show bottleneck species in the mix.

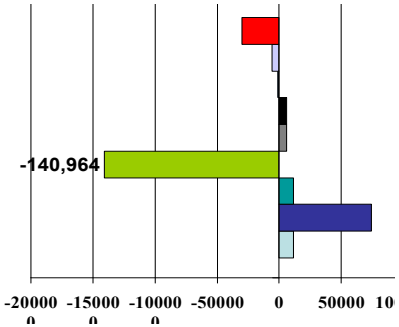
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



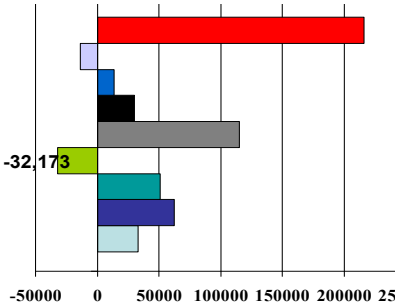
Current-1999



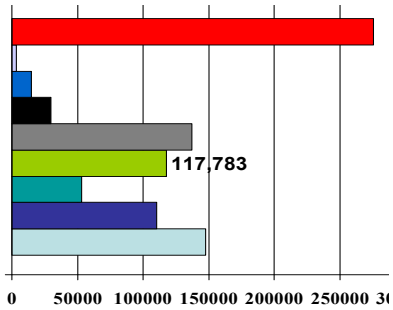
Scenario 1



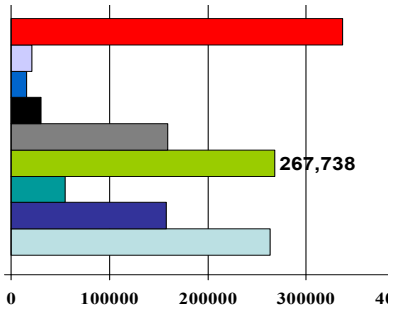
Scenario 2



Scenario 3



Scenario 4



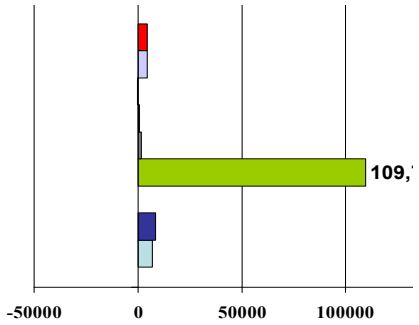
Scenario 5

North Central Pulp and Paper

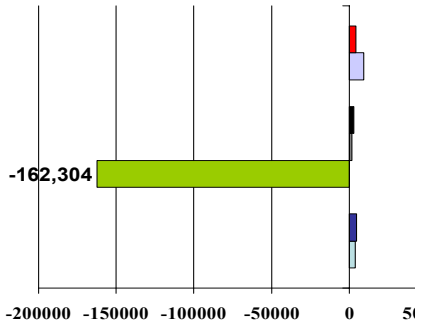
Species Mix Scenarios Showing Supply Bottlenecks- 10% Decrease

Negative supply numbers show bottleneck species in the mix.

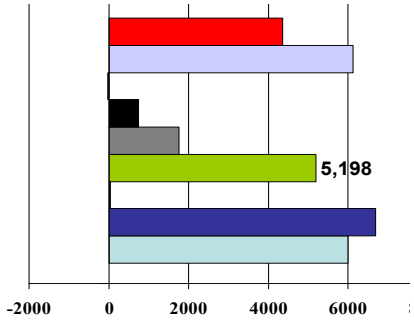
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



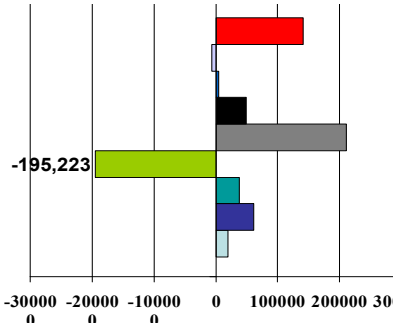
Current-1999



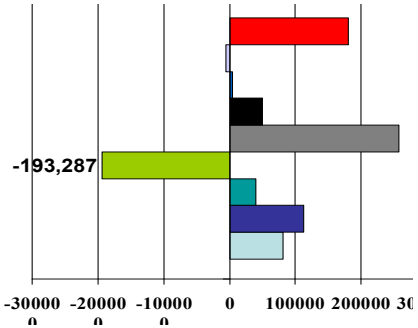
Scenario 1



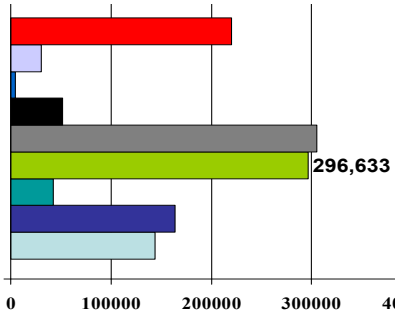
Scenario 2



Scenario 3



Scenario 4



Scenario 5

Table 10: NE, NC and Combined Regions, Pulp and Paper Sector, 10% increase from 1999, Bottlenecks as negative numbers

	NE Pulp and Paper	10% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$608,080,000												
Balsam Fir	0.000130714	79,485	72,527	(6,958)	67,627	(11,858)	76,448	(3,037)	98,010	18,525	212,682	133,197	328,334	248,849
White Birch	0.000133585	81,230	73,656	(7,574)	127,057	45,827	140,867	59,637	128,898	47,668	176,774	95,544	224,651	143,421
Maple	8.9126E-06	5,420	4,950	(470)	10,890	5,470	15,840	10,420	55,440	50,020	57,420	52,000	59,400	53,980
Aspen	0.000994493	604,732	551,796	(52,936)	320,493	(284,239)	353,816	(250,916)	462,607	(142,125)	612,563	7,831	762,518	157,786
Mixed Hardwoods	2.40542E-05	14,627	13,306	(1,321)	12,355	(2,272)	18,058	3,431	127,354	112,727	149,213	134,586	171,072	156,445
Red Pine	3.17872E-05	19,329	16,305	(3,024)	19,325	(4)	21,740	2,411	45,896	26,567	45,896	26,567	46,500	27,171
White Pine	3.27699E-06	1,993	1,485	(508)	594	(1,399)	594	(1,399)	15,444	13,451	16,335	14,342	17,226	15,233
Jack Pine	6.06638E-05	36,888	32,848	(4,040)	21,899	(14,989)	24,245	(12,643)	16,424	(20,464)	33,630	(3,258)	51,619	14,731
Mixed Softwoods	0.000135268	82,254	74,903	(7,351)	31,690	(50,564)	37,452	(44,802)	283,289	201,035	342,827	260,573	404,286	322,032
TOTAL	0.001522755	925,957	841,776	(84,181)	611,930	(314,027)	689,060	(236,897)	1,233,362	307,405	1,647,340	721,383	2,065,606	1,139,649
	NC Pulp and Paper	10% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$743,270,000												
Balsam Fir	9.70232E-05	72,114	65,974	(6,140)	63,063	(9,051)	65,003	(7,111)	78,586	6,472	140,679	68,565	202,772	130,658
White Birch	0.00012047	89,542	81,824	(7,718)	78,062	(11,480)	79,943	(9,599)	134,492	44,950	186,219	96,677	237,006	147,464
Maple	7.67473E-07	570	505	(65)	505	(65)	505	(65)	38,877	38,307	40,897	40,327	42,917	42,347
Aspen	0.001542183	1,146,258	1,047,614	(98,644)	775,544	(370,714)	943,046	(203,212)	742,625	(403,633)	744,561	(401,697)	1,234,481	88,223
Mixed Hardwoods	3.90412E-05	29,018	25,502	(3,516)	25,502	(3,516)	25,502	(3,516)	234,986	205,968	281,437	252,419	328,799	299,781
Red Pine	6.55318E-05	48,708	40,590	(8,118)	43,065	(5,643)	40,590	(8,118)	89,100	40,392	90,090	41,382	91,575	42,867
White Pine	1.34433E-06	999	693	(306)	792	(207)	792	(207)	4,950	3,951	5,148	4,149	5,445	4,446
Jack Pine	9.3792E-05	69,713	61,529	(8,184)	66,429	(3,284)	63,162	(6,551)	50,094	(19,619)	51,183	(18,530)	87,665	17,952
Mixed Softwoods	6.07493E-05	45,153	41,293	(3,860)	41,293	(3,860)	41,293	(3,860)	177,656	132,503	217,988	172,835	257,360	212,207
TOTAL	0.002020903	1,502,076	1,365,524	(136,552)	1,094,255	(407,821)	1,259,836	(242,240)	1,551,366	49,290	1,758,202	256,126	2,488,020	985,944
	Combined Pulp and Paper	10% Increase												
	Total Cords													
			1999 - Current		Scenario 1		Scenario 2		Scenario 3		Scenario 4		Scenario 5	
Tree Species	Demand Coefficients	Demand	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference	Supply	Difference
		$1,351,350,000												
Balsam Fir	0.000112169	151,580	138,501	(13,079)	130,690	(20,890)	141,451	(10,129)	176,596	25,016	353,361	201,781	531,105	379,525
White Birch	0.000126243	170,598	155,480	(15,118)	205,118	34,520	220,810	50,212	263,390	92,792	362,993	192,395	461,657	291,059
Maple	4.43521E-06	5,994	5,455	(539)	11,395	5,401	16,345	10,351	94,317	88,323	98,317	92,323	102,317	96,323
Aspen	0.001296504	1,752,031	1,599,410	(152,621)	1,096,037	(655,994)	1,296,862	(455,169)	1,205,232	(546,799)	1,357,124	(394,907)	1,996,998	244,967
Mixed Hardwoods	3.27143E-05	44,208	38,808	(5,400)	37,858	(6,350)	43,560	(648)	362,340	318,132	430,650	386,442	499,871	455,663
Red Pine	5.10012E-05	68,920	56,895	(12,025)	62,390	(6,530)	62,330	(6,590)	134,996	66,076	135,986	67,066	138,075	69,155
White Pine	2.17917E-06	2,945	2,178	(767)	1,386	(1,559)	1,386	(1,559)	20,394	17,449	21,483	18,538	22,671	19,726
Jack Pine	7.94085E-05	107,309	94,377	(12,932)	88,328	(18,981)	87,407	(19,902)	66,518	(40,791)	84,813	(22,496)	139,283	31,974
Mixed Softwoods	9.41842E-05	127,276	116,196	(11,080)	72,983	(54,293)	78,745	(48,531)	460,944	333,668	560,815	433,539	661,647	534,371
TOTAL	0.001798839	2,430,861	2,207,300	(223,561)	1,706,185	(724,676)	1,948,896	(481,965)	2,784,727	353,866	3,405,542	974,681	4,553,624	2,122,763

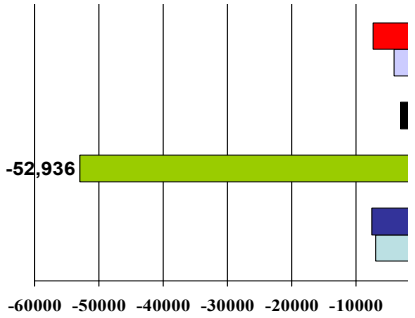
Source: IMPLAN, BBER, MFRC

Northeastern Pulp and Paper

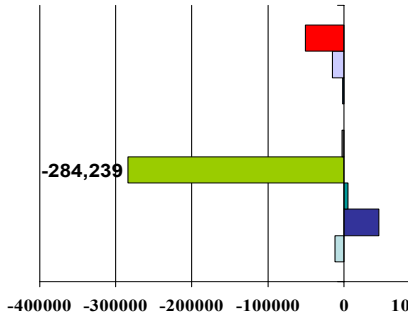
Species Mix Scenarios Showing Supply Bottlenecks- 10% Increase

Negative supply numbers show bottleneck species in the mix.

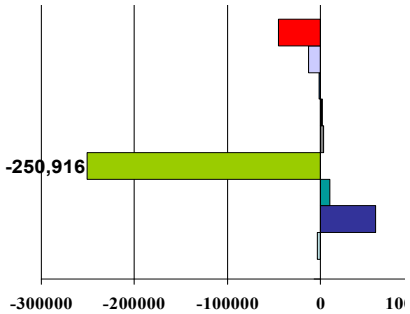
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



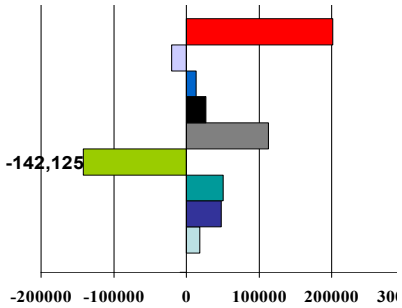
Current-1999



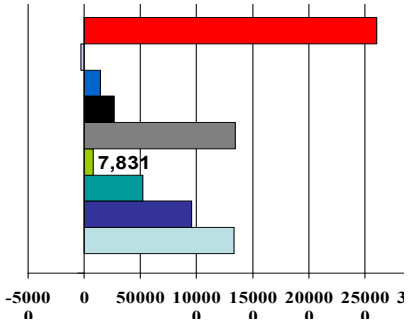
Scenario 1



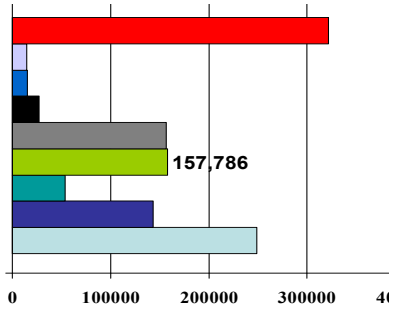
Scenario 2



Scenario 3



Scenario 4



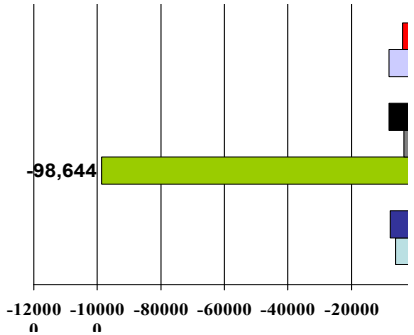
Scenario 5

North Central Pulp and Paper

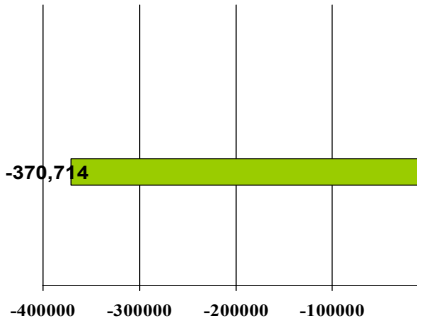
Species Mix Scenarios Showing Supply Bottlenecks- 10% Increase

Negative supply numbers show bottleneck species in the mix.

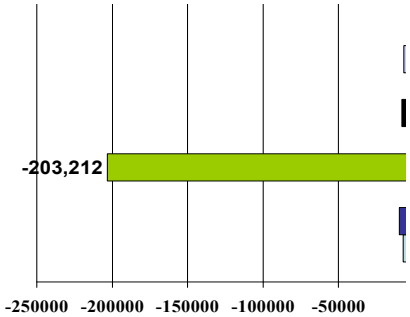
- Mixed Softwoods
- Jack Pine
- White Pine
- Red Pine
- Mixed Hardwoods
- Aspen
- Maple
- White Birch
- Balsam Fir



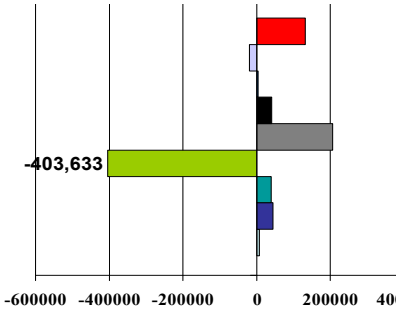
Current-1999



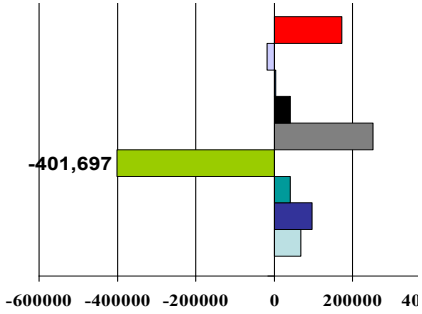
Scenario 1



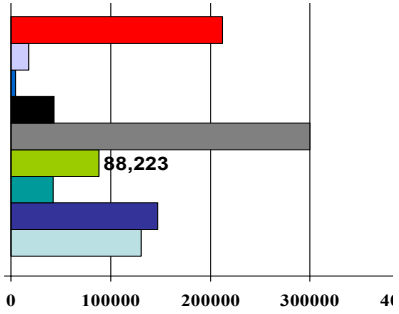
Scenario 2



Scenario 3



Scenario 4



Scenario 5

IMPLAN Impacts

This report provides Northeast and North Central Regions' Employment, Value Added, Output impacts, calculated for three industry sectors: Pulp and Paper RWP, Sawmills, Specialty Woods. Impacts calculated from data supplied by the IMPLAN model. Impacts are calculated based on the given wood supply. The difference, calculated below, is used in IMPLAN to calculate the three impacts. The following tables show supply supported final demand, or the final demand that can be satisfied. (*The source for all these tables is the IMPLAN data and software package*.)

Table 11: NE, NC and Combined regions, Scenario 1, supply supported final demand

		Scenario I	
North Central Pulp & Paper	**# of Total Cords =**	1365524	
	Final Demand	675700000	0.0020209
	1094255	0.20%	
	Xj		
	Xj =	541,468,406	
	Difference	(134,231,594)	
North East - Pulp & Paper	**# of Total Cords =**	841776.2	
	Final Demand	552800000	0.00152275
	611929	0.15%	
	Xj		
	Xj =	401857823	
	Difference	(150,942,177)	
Combined Pulp & Paper	**# of Total Cords =**	2207300.2	
	Final Demand	1228500000	0.00179674
	1706184	0.18%	
	Xj		
	Xj =	949597632.4	
	Difference	(278,902,368)	

Table 12: NE, NC and Combined regions, Scenario 2, supply supported final demand

		Scenario 2	
North Central Pulp & Paper	**# of Total Cords =**	1365524	
	Final Demand	675700000	0.0020209
	1259836	0.20%	
	Xj		
	Xj =	623402580	
	Difference	(52,297,420)	
North East - Pulp & Paper	**# of Total Cords =**	841776.2	
	Final Demand	552800000	0.00152275
	689060	0.15%	
	Xj		
	Xj =	452510261	
	Difference	(100,289,739)	
Combined Pulp & Paper	**# of Total Cords =**	2207300.2	
	Final Demand	1228500000	0.00179674
	1948896	0.18%	
	Xj		
	Xj =	1084681973	
	Difference	(143,818,027)	

Table 13: NE, NC and Combined regions, Scenario 3, supply supported final demand

Scenario 3

North Central Pulp & Paper	**# of Total Cords =**	1365524	
	Final Demand	675700000	0.002021
	1551366	0.20%	
	Xj		
	Xj =	767659892	
	Difference	91,959,892	
North East - Pulp & Paper	**# of Total Cords =**	841776.2	
	Final Demand	552800000	0.001523
	1233362	0.15%	
	Xj		
	Xj =	809956985.7	
	Difference	257,156,986	
Combined Pulp & Paper	**# of Total Cords =**	2207300.2	
	Final Demand	1228500000	0.001797
	2784728	0.18%	
	Xj		
	Xj =	1549874525	
	Difference	321,374,525	

Table 14: NE, NC and Combined regions, Scenario 4, supply supported final demand

Scenario 4

North Central Pulp & Paper	**# of Total Cords =**	1365524	
	Final Demand	675700000	0.002021
	1758202	0.20%	
	Xj		
	Xj =	870008210	
	Difference	194,308,210	
North East - Pulp & Paper	**# of Total Cords =**	841776.2	
	Final Demand	552800000	0.001523
	1647340	0.15%	
	Xj		
	Xj =	1081819077	
	Difference	529,019,077	
Combined Pulp & Paper	**# of Total Cords =**	2207300.2	
	Final Demand	1228500000	0.001797
	3405542	0.18%	
	Xj		
	Xj =	1895396171	
	Difference	666,896,171	

Table 15: NE, NC and Combined regions, Scenario 5, supply supported final demand

		Scenario 5	
North Central Pulp & Paper	# of Total Cords =	1365524	
	Final Demand	675700000	0.0020209
	2488019	0.20%	
	Xj		
	Xj =	1231142359	
	Difference	555,442,359	
North East - Pulp & Paper	# of Total Cords =	841776.2	
	Final Demand	552800000	0.00152275
	2065605	0.15%	
	Xj		
	Xj =	1356496470	
	Difference	803,696,470	
Combined Pulp & Paper	# of Total Cords =	2207300.2	
	Final Demand	1228500000	0.00179674
	4553624	0.18%	
	Xj		
	Xj =	2534375290	
	Difference	1,305,875,290	

Employment, Value Added, and Output Impacts

From the data we can also calculate detailed reports such as employment impacts for specific industries. Or we can develop percentages to show change. BBER was asked to run percent change calculations for employment, value added and output. Full reports of the IMPLAN impacts are found in the data appendix, including impacts for Employment, Value Added, and Output for Pulp and Paper RWP, Sawmills, Specialty Woods. Note: For perspective on percent change impacts need to be compared to total employment, value added or output for the Region and Sector. Also note: in some cases impacts are very small or insignificant. Further note: impacts suggested in these tables are *potential* impacts.

To determine the three impacts the dollar value of final demand is calculated based on the supply of wood available in each scenario. The calculated final demand is then compared to the 1999 final demand. The difference between the two final demands is the input for IMPLAN, and the results are reported as employment, value added,and output impacts.

Impacts of the supply bottlenecks derived from IMPLAN (employment, value added, and output) are shown here as specific impacts on specific industries. Percent calculations show changes in the degree of impact for the Sector and for the Region.

For each industry sector, that sector's employment is shown along with total regional employment. The direct impact is compared as a percentage to that sector's employment. For example, in the Northeast Region Pulp and Paper, Scenario 2, direct employment loss is -345 jobs, or -16.9 percent of Northeast Region Pulp and Paper employment of 2,039 jobs. As a comparison to total regional employment, that indirect impact employment loss in Scenario 2 is -652 jobs or 0.4 percent of the total regional employment of 144,685. The same percentages are calculated for value added and output on the other tables.

All IMPLAN report impacts for all regions and all industries are available in the data appendix. Tables of calculated percentages follow below. (*The sources for these tables are the IMPLAN data and software package and calculations by the BBER.*)

Table 16: Percent change for sector and region employment

NE Pulp and Paper, Sawmills, Specialty Woods, 1999

Employment Impacts from IMPLAN
Northeast Region

	Change in Direct Employment	% change Sector	Change in Indirect Employment	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	2,039	Total Region Employment =	144,895
Scenario 1	-520	-25.5%	-981	-0.7%
Scenario 2	-345	-16.9%	-652	-0.4%
Scenario 3	885	43.4%	1670	1.2%
Scenario 4	1822	89.3%	3436	2.4%
Scenario 5	2767	135.7%	5220	3.6%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	517	Total Region Employment =	144,895
Scenario 1	-9	-1.7%	-10	0.0%
Scenario 2	3	0.6%	4	0.0%
Scenario 3	187	36.1%	208	0.1%
Scenario 4	235	45.4%	261	0.2%
Scenario 5	285	55.1%	317	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	573	Total Region Employment =	144,895
Scenario 1	60	10.4%	35	0.0%
Scenario 2	107	18.7%	63	0.0%
Scenario 3	583	101.8%	344	0.2%
Scenario 4	583	101.8%	344	0.2%
Scenario 5	595	103.8%	350	0.2%

Table 17: Percent change for sector and region employment

NC Pulp and Paper, Sawmills, Specialty Woods, 1999

Employment Impacts from IMPLAN
North Central Region

	Change in Direct Employment	% change Sector	Change in Indirect Employment	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	2,449	Total Region Employment =	132,416
Scenario 1	-463	-18.9%	-981	-0.7%
Scenario 2	-180	-7.3%	352	0.3%
Scenario 3	317	12.9%	619	0.5%
Scenario 4	670	27.4%	1309	1.0%
Scenario 5	1915	78.2%	3740	2.8%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	389	Total Region Employment =	132,416
Scenario 1	0	0.1%	1	0.0%
Scenario 2	0	0.0%	0	0.0%
Scenario 3	118	30.3%	221	0.2%
Scenario 4	140	35.9%	262	0.2%
Scenario 5	175	44.9%	328	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	1,139	Total Region Employment =	132,416
Scenario 1	-13	-1.1%	-10	0.0%
Scenario 2	-20	-1.7%	-14	0.0%
Scenario 3	638	56.0%	466	0.4%
Scenario 4	656	57.6%	479	0.4%
Scenario 5	856	75.2%	626	0.5%

Table 18: Percent change for sector and region, value added, NE Pulp and Paper, Sawmill, Specialty Woods, 1999

Value Added Impacts from IMPLAN
Northeast Region

	Change in Value Added	% change Sector	Change in Indirect Value Added	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 215.9 m		Total Region Value Added = $6,285.7 m	
Scenario 1	-$55	-25.5%	-$42	-0.7%
Scenario 2	-$37	-17.0%	-$28	-0.4%
Scenario 3	$94	43.4%	$72	1.1%
Scenario 4	$193	89.3%	$147	2.3%
Scenario 5	$293	135.7%	$224	3.6%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 20.2 mil		Total Region Value Added = $6,285.7 m	
Scenario 1	-$0.35	-1.7%	$0.40	0.0%
Scenario 2	-$0.13	-0.6%	-$0.15	0.0%
Scenario 3	$7.30	36.1%	$8.30	0.1%
Scenario 4	$9.20	45.5%	$10.40	0.2%
Scenario 5	$11.10	55.0%	$12.70	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 21.8 mil		Total Region Value Added = $6,285.7 m	
Scenario 1	$2.30	0.4%	$1.50	0.0%
Scenario 2	$4.10	0.7%	$2.60	0.0%
Scenario 3	$22.20	3.9%	$14.30	0.2%
Scenario 4	$20.20	3.5%	$14.30	0.2%
Scenario 5	$22.60	3.9%	$54.30	0.9%

Table 19: Percent change for sector and region value added

NC Pulp and Paper, Sawmills, Specialty Woods, 1999

Value Added Impacts from IMPLAN
North Central Region

	Change in Value Added	% change Sector	Change in Indirect Value Added	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 258.5 m		Total Region Value Added = $5,003.4 m	
Scenario 1	-$49	-18.9%	-$34	-0.7%
Scenario 2	-$19	-7.3%	-$13	-0.3%
Scenario 3	$34	12.9%	$23	0.5%
Scenario 4	$71	27.3%	$49	1.0%
Scenario 5	$202	78.1%	$141	2.8%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 12.4 mil		Total Region Value Added = $5,003.4 m	
Scenario 1	$0.01	0.1%	$0.02	0.0%
Scenario 2	$0.00	0.0%	$0.00	0.0%
Scenario 3	$3.70	29.8%	$7.50	0.1%
Scenario 4	$4.40	35.5%	$8.90	0.2%
Scenario 5	$5.50	44.4%	$11.10	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Value Added = 45.1 mil		Total Region Value Added = $5,003.4 m	
Scenario 1	$2.30	5.1%	$1.50	0.0%
Scenario 2	$4.10	9.1%	$2.60	0.1%
Scenario 3	$22.20	49.2%	$14.30	0.3%
Scenario 4	$20.20	44.8%	$14.30	0.3%
Scenario 5	$22.60	50.1%	$54.30	1.1%

Table 20: Percent change for sector and region of output,

NE Pulp and Paper, Sawmills, Specialty Woods, 1999

Output Impacts from IMPLAN
Northeast Region

	Change in Output	% change Sector	Change in Indirect Output	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Output = $592.1 r		Total RegionOutput = $11,140.8	
Scenario 1	-$151	-25.5%	-$72	-0.6%
Scenario 2	-$100	-16.9%	-$48	-0.4%
Scenario 3	$257	43.4%	$122	1.1%
Scenario 4	$529	89.3%	$252	2.3%
Scenario 5	$804	135.7%	$382	3.4%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Output = $64.1 m		Total RegionOutput = $11,140.8	
Scenario 1	-$1.10	-1.7%	-$0.70	0.0%
Scenario 2	$0.41	0.6%	$0.26	0.0%
Scenario 3	$23.20	36.2%	$14.60	0.1%
Scenario 4	$29.10	45.4%	$18.40	0.2%
Scenario 5	$35.30	55.1%	$22.30	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Output = $52.4 m		Total RegionOutput = $11,140.8	
Scenario 1	$5.40	10.3%	$2.80	0.0%
Scenario 2	$9.80	18.7%	$5.00	0.0%
Scenario 3	$53.30	101.7%	$27.10	0.2%
Scenario 4	$53.30	101.7%	$27.10	0.2%
Scenario 5	$54.30	103.6%	$27.60	0.2%

Table 21: Percent change for sector and region of output,

NE Pulp and Paper, Sawmills, Specialty Woods, 1999

Output Impacts from IMPLAN
North Central Region

	Change in Output	% change Sector	Change in Indirect Output	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Output = $710.3 r		Total RegionOutput = $8,995 mil	
Scenario 1	-$134	-18.9%	-$59	-0.7%
Scenario 2	-$52	-7.4%	-$23	-0.3%
Scenario 3	$92	12.9%	$41	0.5%
Scenario 4	$194	27.4%	$86	1.0%
Scenario 5	$555	78.2%	$245	2.7%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Output = $60.4 m		Total RegionOutput = $8,995 mil	
Scenario 1	$0.06	0.1%	$0.05	0.0%
Scenario 2	$0.00	0.0%	$0.00	0.0%
Scenario 3	$18.30	30.3%	$14.20	0.2%
Scenario 4	$21.70	35.9%	$16.80	0.2%
Scenario 5	$27.10	44.9%	$21.10	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Output = $121.6 r		Total RegionOutput = $8,995 mil	
Scenario 1	-$1.40	-1.2%	-$0.70	0.0%
Scenario 2	-$2.10	-1.7%	-$1.10	0.0%
Scenario 3	$68.20	56.1%	$33.70	0.4%
Scenario 4	$70.00	57.6%	$34.60	0.4%
Scenario 5	$91.40	75.2%	$45.20	0.5%

So what does this means for policy makers?

How good are these numbers? Note that our analyses are reported here in some cases as *potentia*l impacts.

Other mitigating factors might be:

- It is important to note that supply does not create demand without proper pricing, and in this case such pricing could be seen as significant price cuts.
- It is important to remember that there have to be markets for these industries to supply in order for the analyses in this report to deliver as expected.
- It is important to note that transportation costs play a major role in the "big picture," especially when shipping is not transacted by weight (per/lb. for instance) but per unit value (for instance shipping costs for furniture from the Specialty Woods sector).

What this report does not cover:

- We did not look at alternatives relative to land use, e.g., tourism vs. other commercial uses of the forest.
- We did not look at the benefits and costs of alternative land uses.
- We are did not estimate tree supply – this is being provided by the Council.
- We did not look at social/environmental impacts.
- Although we report bottlenecks for the combined region, we did not report specific IMPLAN impacts for the regions combined, because for this model the impacts of the two regions do not equal the impact of a combined region.

The Import/Export picture:

- Exports are a part of final demand
- Imports are a part of final payments
- Final payments affect size of multipliers
- Final demand does not
- Pulp and paper, sawmills, and miscellaneous take exports and imports into account
- Logging does not (physical units)
- It can if data are available

But importantly, with this bottleneck analysis project completed, we now have a model to use for more applications and more scenarios. This model has the flexibility to look at a variety of possible scenarios and changing wood supplies. From the model, we have a range of numbers for the big picture discussion and long-term planning. It's important to note the precision of these estimates is unknown. Any statistical error could arise from both the demand (IMPLAN) or the wood supply estimates (regional landscape committees) that may affect the final results.

The information is based on 1999 data, technology, and productivity. Technology and productivity have improved since 1999. But the exact changes needed for this analysis are not known and changing values would only be guesses in this limited study.

But even if the bottleneck and impact numbers are not completely accurate to the penny, the relative magnitude and direction of the changes are reasonable and valuable. These estimates still provide the best estimates for policymakers based on the best data that is available. These numbers confirm that for long-term planning, GEIS analysis can be used to shape the landscape, when planning includes consequences from the large impact that forest products have on the economy of the region and the state.

Suggestions for further research

A linear program model could be developed. This would involve setting scenarios up with a set of constraints and optimizing the series of equations.

Additional regions could be modeled and analyzed. The Northern Region including Koochiching County needs to be analyzed. This would complete all the regions in the State of Minnesota. Without this region there is a hole in the analysis that limits the effectiveness of any long-range planning.

A separate analysis on imports and exports to determine the dollar values of these components could be researched.

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Appendix A
Project Methodology

1) See a general description of input/output analysis, "A Readymade Input-Output Model" in *Urban Regional Economics: Concepts, Tools, Applications*, by Wilbur R. Maki and Richard W. Lichty. February 2000. Publisher: Iowa State, Press, pp. 233-245, ISBN: 0813826799
2) The Mathematics of the Model

Appendix B
Data and Calculations

1) Impacts from IMPLAN data
2) PowerPoint slides

Appendix A: Project Methodology

1) See a general description of input/output analysis, "A Readymade Input-Output Model" in *Urban Regional Economics: Concepts, Tools, Applications*, by Wilbur R. Maki and Richard W. Lichty. February 2000. Publisher: Iowa State, Press, pp. 233-245, ISBN: 0813826799
2) The Mathematics of the Model
3) Other Approaches - Location Quotients and Shift-Share

1) A Readymade Input-Output Model

The point of departure for this assessment is the suggestion that ". . . a truly flexible readymade model will enable the introduction of survey-based trade coefficients in some sectors while continuing to balance the rest of the sectors in a truly unbiased manner" (Brucker, Campbell, and Latham III, 1990, p.136). System effectiveness requires not only a truly flexible model but one that invites "coefficient fix-up" with superior information, coupled with ". . . software and/or handbooks that guide the user (professional or lay) through the intricacies of final demand determination" (p.137).

Forecasting Area Economic Impacts

Use of the IMPLAN regional modeling system as an impact prediction model starts with the existing database. The U.S. Department of Commerce Regional Economic Measurements Division Annual Regional Economic Information System (REIS) series covering industry employment, labor earnings, total population, and total personal income is a common starting place.[3] The historical (REIS) series include every county in the United States. They cover total employment and total labor earnings in a two-digit industry breakdown based on the 1987 Standard Industrial Classification Manual.

The U.S. IMPLAN database calibrates to the REIS series. The IMPLAN series also use the individual state ES-202 covered (by the cooperative federal-state unemployment insurance program) employment and payroll files, especially for the three- and four-digit industry groups that are not available in the REIS database. IMPLAN has a 528-sector industry breakdown for each of 3,120 counties in the United States.

The 1988 U.S. Department of Commerce Office of Business Economics Regional Series (OBERS) on industry employment, labor earnings, total population, and total personal income extend the corresponding 57-industry REIS series to 2040. The 1988 OBERS series calibrate to the 1988 U.S. Bureau of Labor Statistics (BLS moderate projection series. High and low projection series, which are derived for individual states, MSAS, and the Bureau of Economics economic areas in the auxiliary IMPLAN database, correspond to the U.S. BLS high and low projection series (Kutcher, 1991).

The IMPLAN database extends the OBERS series to equivalent measures of industry output and commodity production in a long-term forecast mode. It further allocates the commodity production to intermediate and final demand sectors in the United States and in each of the 50 states. The intermediate demand sectors include the two-digit industry groups in the OBERS sectors. Individual industries in the 528 sectors of the IMPLAN database aggregate to the three-

and four-digit BLS sectors, the two-digit OBERS sectors, and many other combinations of two- and three-digit industry groups.

The final demand sectors in the IMPLAN database include (1) personal consumption expenditures, (2) gross private capital formation, (3) change in business inventory, (4) federal government purchases, (5*)* state and local government purchases, (6) exports, and (7) imports. Regional purchase coefficients (RPCs) that allocate imports to each local purchasing sector are calculated for each IMPLAN "model" (that is, a county or multicounty impact assessment). The uniquely estimated RPCs produce estimates of local exports and imports that are consistent with levels of industry output and commodity production in each IMPLAN impact assessment.

The IMPLAN-based regional forecast methodology presents a series of readily reproducible steps for converting BLS and OBERS projections to corresponding sets of county forecasts of industry employment, labor earnings, resident population, and personal income. The individual county series track their respective state projection series. Each state has a set of high, low, and moderate projections based on the 1988 OBERS projection series and the corresponding high, low, and moderate 1988 and 1990 BLS projections series for the United States. This method of approach to county-level forecasting thus extends the BLS and OBERS forecasting methods and results. It introduces the BLS county-level modeling capabilities and database for use in industry-specific assessments of local resource requirements and the effects of these requirements on local and state economies.

State, regional, and county projection series relate directly to corresponding data series from the IMPLAN models of one or more counties. Individual IMPLAN regional reports, for example, expand the number of variables that correlate with the two-digit employment and earnings projections, including commodity exports and commodity imports. They also provide a framework for assessing the differential rates of growth of individual counties and regions Each IMPLAN model takes given changes in final demands and derives the effects of these changes on the local economy and its institutions. Included with each IMPLAN model is a social accounting matrix (SAM) for tracking changes in local income distributions in the local economy.

The IMPLAN input-output model has been constructed using 528 industry sectors, although the model can be run for any level of aggregation of these sectors. The underlying coefficients in the model are derived from the U.S. input-output accounts. Flows of goods and services in the Minnesota model are derived from commodities produced and consumed in Minnesota as well as those that are imported into the state and exported to areas outside of the state. The system is run for all regions together to ensure consistency with both U.S. and individual regional input-output accounts.

One very useful aspect of the IMPLAN model is the IMPACT module. It permits the user to evaluate the effects of changes or variations in economic activity. For example, the impact of the direct purchase of goods and services by the air transportation industry can be traced through the economy as a series of spending iterations among all sectors, including households. The long-term multiplier used in the model includes indirect effects (to which multipliers are normally limited) as well as induced effects related to employment and population change.

The U.S. Departments of Commerce, Labor, and Agriculture maintain the *reference data systems*

for Micro-IMPLAN. The Department of Commerce houses the periodic censuses of population and employment, agricultural, manufacturing, wholesale and retail trade, and selected business services, as well as the annual statistical series on personal income and industry employment and earnings of the employed industry workforce. State- and county-level data sources most critical for early fix-up and updating of the current database are the individual state reports on county business patterns, ES-202 files on covered industry employment and payroll, and the agriculture censuses.

A common problem in using each of these data sources is the occurrence of nondisclosures. Use of supplementary information in the biproportional adjustment procedures for filling in the missing data, for example, allow for closer correspondence of the remaining calculated values with values reported by the U.S. Department of Commerce.

Delays in the reporting cycles for reference data systems result in two- to three-year lags in the availability of each new update of the county-level MicroIMPLAN database. Reducing lags in data availability is probably a less feasible alternative, however, than forecasting new control totals for the biproportionally adjusted U.S., state, and county input-output tables.

A hybrid approach that combines local surveys of critically important industries with the forecast approach facilitates the likelihood of attaining both greater timeliness and greater accuracy in regional impact assessments. Such an approach incorporates various measures of linkage between core and peripheral labor market areas, like survey-based estimates of the physical volume and market value of commodity shipments between the core area and periphery.

Delineation of the LMAs within an economic region introduces a spatial structure into the organization of the Micro-IMPLAN database. This helps address the twofold problem focus—system bias and specification error. Each of the problem sources, whether industry production functions, RPCs, marketing margins, or industry output, varies between center and periphery. Investment per worker is lower in the periphery, and rate of return on investment also is lower when discounted for perceived investment risk. However, high levels of commodity trade occur between center and periphery. This emanates from the unique competitive advantage of each of the two types of export-producing systems, with the center specializing in high-order, high-profit services, and the periphery specializing in standardized commodity production.

The use of LMAs and the center-periphery structure of these areas applies especially well to the organization of transportation and local land use impact assessments. Commodity transportation originates from dispersed farms, mines, and factories. It concentrates in major shipping centers that also are the primary and secondary core LMAs of the U.S. trading regions. Air transportation concentrates even more than commodity transportation in the primary core areas. This concentration of high-order economic services near the globally connected air nodes of core metropolitan areas apparently accounts for the higher productivity of both labor and capital in the core areas.

Modeling System Formulation

The first step in model reformation is to calculate *total regional commodity demand.* We multiply the regional absorption matrix by the regional industry output to obtain the intermediate input purchases of each industry. We add our estimate of gross final commodity demand to the

estimate of intermediate demand to obtain total commodity demand. The U.S. estimates of industry purchases include both domestic production and foreign imports. Thus, the input profile for each industry includes all commodity inputs of that industry. In addition, each industry may produce more than one commodity. The estimates of gross domestic exports relate to both the commodity production and the regional demand for this production.

The next step relates to the calculation of *total regional commodity supply.* Again, the estimate of total regional industry output enters into the calculation, but in multiplication with the industry byproduct ratios from the U.S. byproduct matrix. The result is the regional matrix that shows the commodity production (columns) by each industry (rows). These estimates, together with the estimates of institutional commodity output (commodity sales by government and from inventory depletion), yield the total commodity output for the regional economy.

Finally, to estimate trade flows, the *RPC* is the key parameter.[5] The RPC value times the corresponding value in the regional gross use matrix yields the regional industry use of the locally supplied commodity. Similarly, the *import propensity* for a given commodity times the corresponding value in the regional gross use matrix yields the regional *industry domestic imports* of each commodity. This procedure applies also in estimating regional institutional use and regional institutional imports, that is, the commodity purchases for local final demand.

The calculation of *domestic commodity exports* results from subtracting regional commodity demand from regional gross commodity supply. The individual commodity imbalances in the U.S. estimates of foreign exports and imports carry through to the individual county or multicounty Micro-IMPLAN models. Domestic exports and imports theoretically balance for the domestic economy as a whole, but not for individual counties or multicounty areas. However, the criteria for allocating the two sets of exports and imports differ greatly. Micro-IMPLAN allocates U.S. *foreign commodity exports* to regions according to their share of U.S. commodity production. It also allocates U.S. *foreign commodity imports* to regions according to the same rule. Estimates of a region's total imports and total exports thus derive from a variety of data sources and allocation criteria.

While local commodity production provides the basis for allocating foreign exports and imports, uniquely generated local RPCs provide the basis for estimating domestic exports and imports for each county or multicounty area. These estimates of gross domestic imports relate to both commercial production and the demand for this production in a given region. Model reformulation calls for similar criteria in allocating U.S. foreign imports to individual industries and regions.

Interregional trade is synonymous with commodity shipments. Most commodity shipments move from producing areas to export markets by truck, rail, and barge. However, an increasing volume of high-value manufactured products move by air transportation to and from the designated air transportation nodes. These shipments typically move by truck to the larger air transportation nodes, such as Chicago. Micro-IMPLAN currently fails to account for such multimodal shipments.

Technology transfer is an increasingly important form of interregional trade. It is also a singularly important factor in accounting for a region's competitive advantage in specialized production and its export to other regions. It is associated, in part, with the total value of

technology-intensive manufactured products in a given region. Again, Micro-IMPLAN, when conjoined with an optimizing transportation network model, can simulate the local economic effects of technology transfer. This application may extend to the role of a state's research universities in the formation and strengthening of spatially separated, functionally integrated industry clusters. These clusters are viewed by at least one student of regional growth and change as the new industrial systems of the emerging information economy (Saxenian, 1994).

Refinements and Applications

Several types of refinements are available for the outcomes of the preceding steps (Alward et al., 1989). These include (1) changing regional supply, (2) modifying industry production function, (3) editing RPCs, and (4) controlling for induced effects once better information becomes available. Superior local knowledge warrants changing the readymade database values in each category. Superior local knowledge also warrants changing regional purchase coefficients, by institution, industry, or commodity. The RPC adjustments for an industry or institution result in the given change being applied to all commodities, by industry or institution. Overlooked, however, is the further regionalization of the final local sales accounts and the industry margins that convert industry output from producer prices to purchaser prices. This process requires detailed, regionally differentiated estimates of final product sales to households, governments, and businesses. Furthermore, input-output models generally are demand-driven with no supply constraints.

The lack of capacity limits for industry expansion and the assumption of full resource use or availability, including labor, result in overestimating industry production response to demand changes. Fixed-price multipliers add to this problem by overestimating multiplier effects and underestimating the substitution effects from exogenous changes (Koh, Schreiner, and Shin, 1993). Also, the current modeling system sidesteps the issue of commuting effects. These attributes of input-output models ultimately result in underestimating or overestimating factor income responses to market changes.

A Simple Input-Output Model

The model is triggered by changes in final demand; that is, demand for goods or services related to final uses. The components of final demand are exogenous to the model's structural characteristics in much the same way as final payments are, but the role of final demand as an initiator of impacts gives it a unique role in the input-output scheme.

The basic input-output model consists of a series of three separate tables. The first is called the transactions table. The transactions table lists all industrial sectors defined for the purposes of the analysis being conducted. It should be noted that these sectors have to be defined so as to account for every firm in the region. The individual sectors should be relatively homogeneous in terms of their input requirements and output distributions. They should generally be disaggregated enough to highlight the true structure of the region without being so disaggregated as to cause significant problems in data collection or in disclosure of the operations of any one firm in the region.

The transactions table also contains values for final demand, as discussed earlier, as well as the values for final payments. The grand totals of such a table contain the gross outputs for each

industrial sector and the gross inputs required to produce those outputs.

Table 6-1A represents the structure of a hypothetical input-output table with three industrial sectors: extractive, manufacturing, and services. Remember, the sectors should be defined so as to account for every firm in the region. The sectors should also, ideally, be as disaggregated as possible. For these reasons, this represents a very unrealistic example of the size of an actual table. Keeping the size of the model to just three industries, however, makes required computations much simpler. The structure and use of larger tables remains much the same.

One of the most important things to remember when reading an input-output table is that the rows of the table represent sales and the columns of the table represent purchases. Thus, the 700 that appears in the Extractive row and the Manufacturing column indicates that firms in the extractive industry sold $700 worth of goods and services to firms in the manufacturing sector.

TABLE 6-1A Commodity transactions of a regional economy

	Intermediate Demand					
Commodity	Extractive (mil.$)	Manufg (mil.$)	Services (mil.$)	Total (mil.$)	Final Demand (mil.$)	Gross Output (mil.$)
Extractive	100	700	0	800	4,625	5,425
Manufacturing	50	200	0	250	6,400	6,700
Services	75	300	75	450	4,905	5,355
Value added	5,000	5,500	230	10,730	1,800	28,730
Imports	200	0	5,000	5,200	0	5,200
Total inputs	5,425	6,700	5,355	17,480	17,730	33,930

Looked at the other way, we could say that the 700 also represents a $700 purchase by the firms in the manufacturing sector from firms in the extractive sector. The 50 in the Manufacturing row and the Extractive column represents a $50 transaction between manufacturing (the seller) and extractive (the buyer) and so on.

The same industrial sectors identified on the left-hand margin of the table appear along the top of the table. The sales and purchases between these sectors represent sales and purchases of "intermediate" goods and services. These are goods and services produced for the purpose of facilitating further production Semifinished goods would be an obvious example of intermediate production but so would the services of lawyers, bankers, transportation agencies (in al cases not involving a final transportation use), and any other sector input or output oriented toward helping other industries with their own production.

The value added row of the table represents another form of sale—the sale of resources of production to each sector. In a theoretical sense, the resources of production include land, labor, capital, and enterprise. In a more practical sense, this row generally includes the income received by local households for whatever contribution they make to the production process.

These resource inputs are not generally considered to be intermediate even though the sale takes

place so further production can occur. Rather, they represent final inputs that add to the income of households as opposed to industrial sectors.

Imports represent sales to local industries by industries and resource holders outside of the locality's defined boundaries. Although not shown above, in reality final demand accounts for a large, often a major, share of an area's imports; the smaller and less diversified the area, the larger the share. Remember, imports—and exports too, for that matter—are defined in terms of payments.

Finally, final demand consists of sales for final uses. The usual categories making up final demand include household consumption (by households located in the region), government purchases of goods and services, gross private domestic investment (including inventory changes), and exports (again, defined in terms of the payment made).

The gross output and input values are equal. This is due to the fact that the transactions table really represents a type of cost-accounting sheet for a regional economy—debits equal credits. The elements in the table that force this balance (which is a balance by definition) are profits or losses. This is because the final value of output is made up of all the costs that go into production, with profits and losses making up the difference.

In summary, the transactions table has three identifiable parts: the intermediate transactions component, representing sales and purchases between firms; the final payments plus imports component, representing resource inputs into the firm's production plus inputs from outside the region; and final demand, representing the sale of goods and services for final use. The table balances between inputs and outputs, with profit as the balancing mechanism.

The transactions table contains a great deal of useful information in its own right. The regional balance of trade (exports—imports) can be discerned from this table, as can gross regional product (the dollar value of all final goods and services produced with the economy minus imports). The level of interaction between local industries and between industries in the region and household5 can be seen in this table. Finally, the relation between local household income and production is depicted in the transactions matrix.

The principal use for this table is found in the construction of the other two tables of the input-output system. As mentioned, the transactions table alone represents a cost-accounting sheet for the region, nothing more or less. It is descriptive rather than analytical, and it does not allow for general equilibrium analysis of the type previously described without further modification. The next step uses the transactions table to construct a table of direct requirements, often called the technical coefficients matrix.

The question answered by the technical coefficients table is, If each local industrial sector sells to other local industrial sectors some total value of intermediate goods and services so that the purchasing sectors can produce their own output, how much do the purchasing sectors require from the other local sectors per dollar of output? For example, Manufacturing purchased $300 worth of intermediate output from Services in order to facilitate its own production of $6,700 worth of intermediate and final outputs. How much did Manufacturing buy from Services per dollar of gross output? The answer is 300/6,700 = $0.45. The same computation can be made for each intermediate sale and purchase in the transactions table. The result of these divisions is

shown in Table 6-2A.

TABLE 6-2A

Commodity	Extractive (mil.$)	Manufg (mil.$)	Services (mil.$)
Extractive	0.018	0.104	0.000
Manufacturing	0.009	0.030	0.000
Services	0.014	0.045	0.014
Subtotal	0.041	0.179	0.014
Value added	0.922	0.821	0.043
Imports	0.037	0.000	0.934
Total inputs	1.000	1.000	1.000

The rows are still read as sales and the columns as purchases. Only now the sales are in terms of cents per dollar, and the purchases have the special interpretation of "input requirements" per dollar of output. We call these input requirements because they represent requirements during the period of analysis in order for each sector to produce its own outputs, scaled down to a "dollar of output" basis.

The technical coefficient matrix represents a recipe for production. To pro-duce one dollar's worth of output, the extractive industry needed a pinch of its own intermediate output, a dash of the intermediate output of the manufacturing sector, and a smidgen of the intermediate products of the services industry. For Manufacturing to produce a dollar's worth of output, it required a pinch from Extractive, a dash from Manufacturing, and a smidgen from Services. And so it goes through all the identified industries for the region.

One of the key assumptions of input-output analysis, as mentioned earlier, is that this recipe does not change, regardless of the level of output. Thus, if the extractive industry were to experience an increase in final sales equal to $10,000 it would require another $180 worth of intermediate products from its own firms, $90 from Manufacturing, and $140 from Services. It should be emphasized that this process starts with a change in the final sales of an industry, or from "exogenous" forces The coefficients in the inter-industry section of the table represent the "endogenous" component of the table

It can be seen that this first computed table gives the analyst limited ability for impact analysis He or she could go through the process of assuming any number of changes in the final sales of the identified industries, multiply these assumed changes by the direct requirements coefficients, and come up with estimates as to the direct effects from these changing final sales on each identified industry in the region To make sure that this process is understood, one might ask, What is the direct effect on each regional industry from an increase in the exports from the manufacturing sector equal to $10 million? The answer is that Manufacturing would increase by $10 million plus a direct intermediate production effect of $300,000, for a total of $10.3 million, the extractive industry would find its intermediate production increasing by $1.04 million, and the services industry would see its intermediate production increase by $450,000.

But this is not the end of the story If each industry has to increase its output in order to service the increase in final sales of the manufacturing industry, then each must, in turn, increase its intermediate purchases and sales from and to one another to service this second round of expansion in activity The second round must then be serviced by a third round of outputs.

TABLE 6-3A Round one of $10 million change in final sales

	Intermediate (mil.$)	Final (mil.$)
Extractive	0.300	0.000
Manufacturing	1.040	10.000
Services	0.450	0.000
Total	1.790	10.000

TABLE 6-4A Round two of $10 million change in final sales

Commodity	Extractive (thou.$)	Manufg. (thou.$)	Services (thou.$)	Total (thou.$)
Extractive	18.720	31.200	0.000	499.200
Manufacturing	9.360	9.000	4.050	106.650
Services	14.560	4.200	6.300	156.100
Total	42.640	325.200	10.350	761.950

Each round is smaller than the previous one due to leakages to imports and to local value added, until the process has completely played itself out. The first of three rounds of such a $10,000 increase in final sales is shown in Table 6-3A.

Note that the only exogenous change is the initial change in final demand assumed for the manufacturing industry. The rest of the sales represent the direct first-round results from those sales on the intermediate output of all industries in the region, including Manufacturing. These are recipe requirements for Manufacturing to produce the hypothesized increased final sales.

Table 6-4A presents second-round totals. Note that Manufacturing requires still more intermediate inputs from its own firms, this time to service the additional $300,000 of output it had to produce to directly allow for the initial $10 million increase in final sales. Similarly, the services industry needs to buy from each of the other industries to enable it to produce the additional $450,000 directly required by Manufacturing. Finally, the extractive industry must have additional inputs to produce its additional $1,040,000 for Manufacturing. The rounds of production in Table 6-4A are *indirect* impacts.

Manufacturing has now increased its sales three times: the $10 million that was initially

assumed, the $300,000 needed to directly service that increase in final sales, and the $22,410 to service the $300,000 in the first round. The extractive industry has increased its sales by $1,040,000 to service the final sales

TABLE 6-5A Round three of $10 million change in final sales

Commodity	Extractive (thou.$)	Manufg. (thou.$)	Services (thou.$)	Total (thou.$)
Extractive	0.899	2.331	0.000	3.230
Manufacturing	0.449	0.672	0.225	1.346
Services	0.699	0.351	0.351	1.401
Total	2.047	3.354	0.576	5.977

TABLE 6-6A Direct and indirect input requirements

Commodity	Extractive (inil.$)	Manufg. (mil.$)	Services (mil.$)
Extractive	1.019	0.109	0.001
Manufacturing	0.010	1.032	0.010
Services	0.015	0.049	1.015
Total	1.044	1.190	.026

change for Manufacturing plus the $49,000 to service that first-round increase, for a total of $1,089,920 to this point And so it goes.

We will now run through a third round of increased production (Table 6-5A), this time to service the second round.

Each additional round is computed in the manner shown above, and the totals are added to determine the total direct and indirect effects from the initial assumed change in the final sales of one of the regional industries. This process is obviously cumbersome. It would be even more difficult—impossible, probably— to work such an iterative scheme for a larger number of industries or for higher direct coefficient values. Fortunately, the system of simultaneous equations represented by an input-output system can be solved using high-speed computers in a matter of seconds, even for the largest of tables. The solution for the system in this example is given in Table 6-6A

The diagonal of Table 6-6A shows “ones” plus some other number (for example, 1.032 in row 2, column 2.) These ones represent the dollar increase to final sales of the industry for which such an exogenous change is assumed. The numbers appearing after the decimal represent the direct (shown in Table 6-2A) plus indirect effects from each assumed change in final sales. Thus, the $10 million change for the example using Manufacturing turns into $10,320,000 total - increase in Manufacturing sales: $10 million to final sales, $300,000 in direct ~ sales, and $20,000 in indirect sales. That $10 million in Manufacturing sales turns into an increase of $1,090,000 in

sales by the extractive industry— $1,040,000 of that direct and $50,000 indirect. Finally, the $10 million assumed increase in manufacturing leads to an increase of $490,000 in the sales of services—$4 50,000 of that direct and $40,000 of that indirect.

The total impact on all of the industries in the region combined is $11.9 million (1.190 X 10 million). The 1.190 is called the demand multiplier for Manufacturing, or the total direct and indirect purchases this sector must make from itself and from the other regional industries in order to produce one dollar's final output. To conduct an impact study, simply multiply an assumed change in final demand for any of the industries by the demand multiplier for that same industry. This indicates the direct and indirect effects on the region resulting from the assumed change. The impacts stem from the fact that industries in a region interact with one another through their purchases from and sales to one another. The greater this level of interaction, the greater the industrial demand multiplier.

Thus, the input-output model represents a detailed accounting of the economic base of a region. It can be used to delineate the export structure of the regional economy and the multipliers that emerge from that structure. It also identifies, in final demand, the relationship between local activity, investment, and export activity in relation to the identified industrial structure. As in most models, its weakness is in its assumptions. But, at the least, the input output system can be used for simulations and sensitivity analyses for a regional economy.

Notes

1. According to *The American Heritage Dictionary*, 3d ed., version 3.6a, Houghton Mifflin Company, New York, 1993, *predict* means "to state or tell about, or make known in advance, especially on the basis of special knowledge." Somewhat along the same line, *project* means "to calculate, estimate, or predict (something in the future), based on present data or trends."

2. The Standard Industrial Classification (SIC) is the statistical classification underlying all establishment-based federal economic statistics classified by industry. This classification was established by the Office of Management and Budget and is used widely by states, industries, and analysts. The Major Group SIC 45 (Air Transportation) is a two digit classification (that is, the group number consists of two digits) and includes the following four-digit subcategories: Air Transportation, Scheduled (4512); Air Courier Services (4513); Air Transportation, Nonscheduled (4522); Airports, Flying Fields, and Airport Terminal Services (4581).

3. U.S. Department of Commerce, Regional Economic Measurements Division. *Regional Economic Information System*: Unpublished series, 1969—1990.

2) The Mathematics of the Model

The basic input-output model is production oriented and was developed by Wassily Leontief in the 1940's. It attempts to make operational the concept of general equilibrium, first discussed in detailed theoretical terms by Leon Walras.

The standard structural equation for an input-output model is as follows:

(1) $$Yj = x1j + x2j + ... + Fj + Mj$$

where: Yj is the gross dollar inputs of purchasing industry j,
xij is the intermediate dollar sales from selling industry i to purchasing industry j,
Fj is the final payments of purchasing sector j, primarily payments to value added components in the economy, and
Mj represents purchases from imports.

The same model from a sales, rather than purchases, point of view takes the following form:

(2) $Yi = xi1 + xi2 + ... + xij + Di$

where: Yi is the gross dollar output of selling industry i,
xij is as before, and
Ci is the sales of selling industry i to final uses (consumption, government, investment, and exports).

These equations make up the transactions table of an input-output system, dividing the economy into i = j sectors and tracing through the stages of production as a good or service moves toward the final sale.

The transactions table is descriptive rather than analytical. To make the model analytical, a direct coefficient must be computed as follows:

(3) $aij = xij/Yj$.

This is the percentage of gross output required by the purchasing industry in the form of intermediate outputs from the selling industries. Then:

(4) $Yi = aijYj + Di$.

Putting the model in vector/matrix form, there is a column vector of outputs, Y, a matrix, AY or X, of xij coefficients written in terms of the definition for technical coefficients, (xij = aijYj) and a column vector of final demands, or:

(5) $Y = AY + D$.

If we assume the technical coefficients are constant, we can solve for this linear set of equations. The result will be industrial demand multipliers based on each industry's need to purchase intermediate outputs from the other industries in the region in order to produce a dollar's worth of output in the reference industry. The solution is as follows:

(6) $Y = AY + D$
(7) $(I - A)Y = D$
(8) $Y = (I - A)^{-1}D$

Where: I is the identity matrix,
Y is a column vector of gross outputs,
D is a column vector of final demands,
A is a matrix of technical coefficients, and
$(I - A)^{-1}$ is the Leontief inverse. This inverse represents the direct and indirect input requirements of all industries in a region in order to produce a dollar's worth of output. It is out of this matrix that industrial demand multipliers are determined.

Thus, the most usual form of input-output analysis emphasizes the input structure of the economy. This is because most tables are constructed for relatively large areas where production relationships are deemed to be the most important. The emphasis on production would miss the point for small economies since little or no manufacturing activity takes place in such rural areas. For these economies, the emphasis should be on trade rather than production relationships.

3) Other Approaches - Location Quotients and Shift-Share

Location Quotients: What Are They?

There are many ways to estimate a region's base. The simplest is the location quotient. The location quotient utilizes several restrictive assumptions that constitute the technique's weaknesses. However, the location quotient can tell a researcher much about a region's economy in a short period of time and with a minimum of data requirements.

The location quotient is equal to the percentage of a reference region's activity in a particular industry divided by the percentage of activity in that same industry for a larger region, usually the nation. The formula for such a quotient is:

$$LQ = \frac{Ri/R}{Ni/N}$$

where: Ri represents the regional activity in industry i,
R represents total regional activity,
Ni represents the national (or other larger region) activity in industry i, and
N represents total national (or other larger region) activity.

Assuming the regional industries are technologically similar to their national counterparts and that the nation is relatively self-sufficient in the production of each industry's products:

$LQi = 1$ indicates that this industry produces at the same level as its national counterpart. If the nation is self-sufficient in the production of this commodity, then so is the region. Therefore, there are no exports or imports associated with this regional industry.

$LQi > 1$
indicates that this industry is producing at a level that is greater than self-sufficiency would indicate. The surplus must be exported. In other words, this is an industry that is identified as a regional exporter.

$LQi < 1$ indicates that this regional industry is producing at a level that is less than self-sufficiency would indicate. The deficit in supply must be imported.

The assumptions associated with the location quotient are obviously restrictive. However, if nothing else, the location quotient does provide an indication of the relative concentration of a particular industry in a region. The greater the location quotient value, the more important this industry is to the economic base of the region. What is more, changes in location quotient values

over time represent changes in the industry's relative importance to the region's economic base. As such, location quotients are quite valuable as indicators of a region's economic base.

Shift-share: What is it?

Related to the location quotient is the shift-share model. While location quotients help identify a region's economic base at a point in time, shift-share looks at changes in the region's base through time, again relative to a larger region such as the nation. The state of Minnesota might be compared to the United States, Northeast Minnesota might be compared to the United States, or the Northeast region might be compared to the state.

Shift-share is a descriptive tool that compares the smaller region with the larger region in terms of trends. These trends can be computed in terms of employment, income, value added, output, or any other economic measure for which data are available. Trend means "through time," and in this project shift-share compares trends in employment between 1994 to 1998 for the study region against the United States.

Comparisons are made on the basis of industrial sectors. If the broader region grows faster than the reference region (such as Northeast, Minnesota), the smaller region's industries may be said to perform poorly by comparison. Even if the smaller region shows an absolute rate of growth in employment for a particular industry, the industry may be found to lag in relative terms. Of course, the opposite may be true when the reference region's industries outperform the nation. Shift-share breaks regional performance into four categories: the share, the mix, the competitive, and the absolute components. In the definitions to follow, we assume that employment is the relevant economic measure used.

The Share Component. The employment in each industrial category, defined in as great a detail as data will allow, is tabulated for the base year of the analysis. The rate of growth in total employment for the larger region is then applied to the base employment for each reference region industrial category.

For example, assume that the rate of growth in total employment for the United States was 10% between the years 1994 and 1998. Assume further that employment in the Furniture Manufacturing industry within the reference region is equal to 100 employees in 1994. If this industry performed up to the average growth in employment for all industries in the larger region, we would expect to find the base of 100 + 10 additional employees in Furniture Manufacturing in 1998. The +10 would be this industry's share of employment growth if it performed up to national average based expectations.

It would be unusual to find the expectation and the reality to be equal. An average is just that, an average. Some industries will perform above that average, others below. The next two components account for the difference between actual performance and the hypothetical, expected performance.

The Mix Component. At any one time, in the larger region, some industries might be identified as fast growing while some others as slow growing. Shift-share attaches specific meanings to fast and slow growing.

fast growing: If an industry has a larger percentage of employment growth than the overall average, we call that industry fast growing.

slow growing: If an industry has a smaller percentage of employment growth than the overall average, we call that industry slow growing.

Assume again that the average rate of growth in the larger region is equal to 10% between 1990 and 1993. Now assume the Furniture industry in this larger region grew by 20% over the same three-year period. Furniture is identified as fast growth because it outperformed the national average by 10%. Applying this 10% difference (20% - 10%) to the Furniture industry employment in the 1994 reference region predicts 100 + 10 additional employees by 1993, due to the fact that the reference region originally contained 100 employees in an identified as being fast growing.

So far, we have predicted a 10 employee increase in the Furniture industry based on this industry's share relative to an overall average. We have also predicted an additional 10 employees in Furniture employment because of a favorable industry mix due to the presence of a fast growing industry. With no additional analysis, we have predicted an industry growth in employment from 100 individuals in 1994 to 120 employees in 1998.

Now let's assume that the reference region's Furniture industry registered an actual increase in employment of 40 over this four-year period (to a total of 140 employees). This is an increase of 20 employees beyond what would be predicted from the share and the mix components. How can we account for this difference?

The reference region not only participated in the larger region's good fortune with respect to the Furniture industry, but it outperformed expectations based on the larger region by an additional 20 employees. The only real explanation for this greater than expected performance is that the reference region had some competitive advantage that allowed it to attract more employees than could be explained by the mix and share effects.

Competitive component. We call these additional 20 employees a gain due to the competitive component within shift-share.

Of course, it is not always true that all the components will hold positive values. The share component will always be positive as long as the larger region posted a gain in employment over the specified time period. The mix component's sign depends on whether the industry being analyzed outperformed or under performed the larger region's overall average. And the competitive component's sign depends upon whether, after adding the share and mix components, there remains a positive value between the actual growth in employment in the industry and the share/mix expectations. If the value is negative, we conclude the reference region lost competitive advantage relative to the larger region.

What follows are the equations used to compute shift-share. If it was difficult to understand the verbal explanation for shift-share, perhaps these equations will help to clarify detailed points.

The equation for a single industry with the reference region being compared to the U.S. is as follows. The first term on the right hand side of the equation represents the share, the second

term represents the mix, and the last represents the competitive. Added together, the three equal the actual change in employment experienced by industry i in the reference region, or Δei.

$$\Delta ei = ei[(US^*/US) - 1)] + ei[(USi^*/USi) - (US^*/US)] + ei[(ei^*/ei) - (USi^*/USi)].$$

where:
- Δei = The absolute change in reference region employment in industry i,
- ei = Reference region employment in industry i, the beginning of the time period,
- ei* = Reference region employment in industry i, the end of the time period,
- US *= Total U.S. employment at the end of the period,
- US = Total U.S. employment at the beginning of the period, and
- USi = U.S. employment in industry i.

Appendix B: Data and Calculations

1) Impacts from IMPLAN data
2) PowerPoint slides

Pulp and Paper RWP:

IMPACT NAME: □Scenario1 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthEast.iap					
		Employ	Employ	VA	Va	Output	Output
Industry		Direct*	Indirect*	Direct*	Indirect*	Indirect*	Induced*
1	Agriculture	0	-7.6	0	-142252	-234785	-104506
28	Mining	0	-2	0	-117419	-389590	-82502
48	Construction	0	-35.7	0	-1686992	-4111588	-825231
58	Food Processing	0	-0.3	0	-22041	-73802	-176552
108	Textiles	0	-0.5	0	-11240	-41513	-245169
133	Logging Camps and Contractors	0	-0.5	0	-30148	-83934	-552
134	Sawmills	0	-52.1	0	-2037366	-6454701	-43233
137	Wood Products	0	-4.2	0	-159482	-383452	-114544
146	Pulp & Paper RWP	-519.7	-5.3	-55032608	-562116	-1541760	-253477
150	Manufacturing	0	-35.9	0	-1939552	-5852025	-1382081
433	Transportation	0	-86	0	-4590051	-8831591	-1443223
441	Services	0	-750.4	0	-30718492	-43798488	-40186044
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	-80638
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-519.7	-980.4	-55032608	-42017151	-71797228	-44937752
	37502						
IMPACT NAME:□ Scenario2 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthEast.iap					
		Employ	Employ	Va	Va	Output	Output
	Industry	Direct*	Indirect*	Direct*	Indirect*	Indirect*	Induced*
1	Agriculture	0	-5	0	-94516	-155997	-69437
28	Mining	0	-1.3	0	-78016	-258853	-54816
48	Construction	0	-23.7	0	-1120879	-2731841	-548304
58	Food Processing	0	-0.2	0	-14645	-49036	-117305
108	Textiles	0	-0.3	0	-7468	-27583	-162897
133	Logging Camps and Contractors	0	-0.4	0	-20031	-55768	-367
134	Sawmills	0	-34.6	0	-1353676	-4288664	-28725
137	Wood Products	0	-2.8	0	-105964	-254775	-76106
146	Pulp & Paper RWP	-345.3	-3.5	-36565036	-373484	-1024384	-168417
150	Manufacturing	0	-23.9	0	-1288687	-3888231	-918289
433	Transportation	0	-57.2	0	-3049744	-5867929	-958913
441	Services	0	-498.6	0	-20410130	-29100806	-26700608
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	-53578
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-345.3	-651.4	-36565036	-27917240	-47703865	-29857761

Pulp and Paper RWP:

37502							
IMPACT NAME:□ Scenario3 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthEast.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Direct*	Indirect*	Indirect*	Induced*
1	Agriculture	0	12.9	0	242352	399998	178045
28	Mining	0	3.4	0	200044	663735	140557
48	Construction	0	60.9	0	2874092	7004826	1405928
58	Food Processing	0	0.5	0	37551	125735	300788
108	Textiles	0	0.8	0	19150	70725	417690
133	Logging Camps and Contractors	0	0.9	0	51363	142996	940
134	Sawmills	0	88.7	0	3471017	10996737	73655
137	Wood Products	0	7.1	0	271707	653278	195147
146	Pulp & Paper RWP	885.4	9	93757888	957663	2626656	431844
150	Manufacturing	0	61.2	0	3304374	9969971	2354621
433	Transportation	0	146.5	0	7819972	15046195	2458789
441	Services	0	1278.4	0	52334444	74618560	68464112
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	137381
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		885.4	1670.3	93757888	71583728	122319413	76559496
37502							
IMPACT NAME:□ Scenario4 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthEast.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*
1	Agriculture	0	26.5	0	498563	0	822870
28	Mining	0	7	0	411528	0	1365425
48	Construction	0	125.2	0	5912534	0	14410210
58	Food Processing	0	1	0	77249	0	258660
108	Textiles	0	1.6	0	39395	0	145495
133	Logging Camps and Contractors	0	1.9	0	105662	0	294169
134	Sawmills	0	182.5	0	7140518	0	22622304
137	Wood Products	0	14.7	0	558950	0	1343913
146	Pulp & Paper RWP	1821.5	18.6	192877168	1970091	529019072	5403520
150	Manufacturing	0	125.8	0	6797703	0	20510058
433	Transportation	0	301.5	0	16087115	0	30952780
441	Services	0	2629.8	0	107661544	0	153504048
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		1821.5	3436.1	192877168	147260850	529019072	251633453

Pulp and Paper RWP:

	37502							
IMPACT NAME: Scenario5 MULTIPLIER: Type SAM								
Copyright MIG	2002	NorthEast.iap						
		Employ	Employ	VA	VA	Output	Output	
	Industry	Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*	
1	Agriculture	0	40.3	0	757428	0	1250120	
28	Mining	0	10.6	0	625201	0	2074382	
48	Construction	0	190.3	0	8982441	0	21892282	
58	Food Processing	0	1.5	0	117358	0	392961	
108	Textiles	0	2.5	0	59849	0	221039	
133	Logging Camps and Contractors	0	2.8	0	160524	0	446908	
134	Sawmills	0	277.2	0	10848018	0	34368260	
137	Wood Products	0	22.3	0	849168	0	2041700	
146	Pulp & Paper RWP	2767.2	28.3	293022880	2993008	803696448	8209152	
150	Manufacturing	0	191.2	0	10327207	0	31159294	
433	Transportation	0	458	0	24439870	0	47024088	
441	Services	0	3995.3	0	163561584	0	233206448	
524	Rest Of The World Industry	0	0	0	0	0	0	
525	Domestic Services	0	0	0	0	0	0	
526	Dummy	0	0	0	0	0	0	
527	Dummy	0	0	0	0	0	0	
528	Inventory Valuation Adjustment	0	0	0	0	0	0	
25001	Foreign Trade	0	0	0	0	0	0	
28001	Domestic Trade	0	0	0	0	0	0	
		2767.2	5220.2	293022880	223721655	803696448	382286635	

Sawmills:

			North East					
	Copyright MIG		IMPACT NAME: Sawmill Scenario 1					
		Employ	Employ	VA	VA	Output	Output	
	Industry	Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*	
1	Agriculture	0	-1.004349	0	-18893.5293	0	-31183.4082	
28	Mining	0	-0.003739	0	-219.8816223	0	-729.5545654	
48	Construction	0	-0.147288	0	-6953.891113	0	-16948.23828	
58	Food Processing	0	-0.000697	0	-53.56707764	0	-179.3641968	
108	Textiles	0	-0.001249	0	-30.16386414	0	-111.4037247	
133	Logging Camps and Contractors	0	-0.012818	0	-724.8244629	0	-2017.953491	
134	Sawmills	-8.89666	-1.251431	-348158.2188	-48972.98047	-1103021	-155154.25	
137	Wood Products	0	-0.056115	0	-2133.728271	0	-5130.236328	
146	Pulp & Paper RWP	0	-0.014358	0	-1520.412109	0	-4170.151367	
150	Manufacturing	0	-0.075717	0	-4090.726563	0	-12342.55762	
433	Transportation	0	-0.948504	0	-50613.92188	0	-97384.86719	
441	Services	0	-6.377645	0	-261092.6094	0	-372266.375	
524	Rest Of The World Industry	0	0	0	0	0	0	
525	Domestic Services	0	0	0	0	0	0	
526	Dummy	0	0	0	0	0	0	
527	Dummy	0	0	0	0	0	0	
528	Inventory Valuation Adjustment	0	0	0	0	0	0	
25001	Foreign Trade	0	0	0	0	0	0	
28001	Domestic Trade	0	0	0	0	0	0	
	Total	-8.89666	-9.893911	-348158.2188	-395300.2361	-1103021	-697618.36	

Sawmills, Northeast:

	Copyright MIG		IMPACT NAME: Sawmill Scenario 2	MULTIPLIER: Type SAM				
			Employ	Employ	VA	VA	Output	Output
	Industry		Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*
1	Agriculture		0	0.370224	0	6964.539551	0	11494.83984
28	Mining		0	0.001378	0	81.05284882	0	268.9286804
48	Construction		0	0.054293	0	2563.345947	0	6247.46582
58	Food Processing		0	0.000257	0	19.74591637	0	66.11729431
108	Textiles		0	0.00046	0	11.11901474	0	41.06568146
133	Logging Camps and Contractors		0	0.004725	0	267.1850586	0	743.8587646
134	Sawmills		3.27949	0.461303	128338.2031	18052.44336	406596	57193.03125
137	Wood Products		0	0.020685	0	786.5356445	0	1891.109497
146	Pulp & Paper RWP		0	0.005293	0	560.454834	0	1537.202637
150	Manufacturing		0	0.027911	0	1507.924927	0	4549.717773
433	Transportation		0	0.349638	0	18657.32227	0	35898.04688
441	Services		0	2.35093	0	96244.05469	0	137224.9688
524	Rest Of The World Industry		0	0	0	0	0	0
525	Domestic Services		0	0	0	0	0	0
526	Dummy		0	0	0	0	0	0
527	Dummy		0	0	0	0	0	0
528	Inventory Valuation Adjustment		0	0	0	0	0	0
25001	Foreign Trade		0	0	0	0	0	0
28001	Domestic Trade		0	0	0	0	0	0
			3.27949	3.647097	128338.2031	145715.7241	406596	257156.3529

	Copyright MIG			IMPACT NAME: Sawmill Scenario 3	MULTIPLIER: Type SAM			
			Employ	Employ	VA	VA	Output	Output
Industry			Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*
1	Agriculture		0	21.07921	0	396536.0938	0	654475.25
28	Mining		0	0.078478	0	4614.860352	0	15311.8418
48	Construction		0	3.091265	0	145947.7969	0	355708.4688
58	Food Processing		0	0.014631	0	1124.262207	0	3764.483643
108	Textiles		0	0.026212	0	633.0771484	0	2338.133789
133	Logging Camps and Contractors		0	0.269021	0	15212.56738	0	42352.67188
134	Sawmills		186.7225	26.26496	7307121	1027841.938	23150130	3256368
137	Wood Products		0	1.17774	0	44782.54297	0	107673.0469
146	Pulp & Paper RWP		0	0.30135	0	31910.30469	0	87522.85156
150	Manufacturing		0	1.589141	0	85855.89063	0	259044.7656
433	Transportation		0	19.90714	0	1062281.5	0	2043907
441	Services		0	133.8536	0	5479794	0	7813101.5
524	Rest Of The World Industry		0	0	0	0	0	0
525	Domestic Services		0	0	0	0	0	0
526	Dummy		0	0	0	0	0	0
527	Dummy		0	0	0	0	0	0
528	Inventory Valuation Adjustment		0	0	0	0	0	0
25001	Foreign Trade		0	0	0	0	0	0
28001	Domestic Trade		0	0	0	0	0	0
			186.7225	207.6527	7307121	8296534.833	23150130	14641568.01

Sawmills, Northeast:

	Copyright MIG		IMPACT NAME: Sawmill Scenario 4 MULTIPLIER: Type SAM				
		Emply Direct*	Emply Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	26.51032	0	498704.5	0	823102.25
28	Mining	0	0.098698	0	5803.88916	0	19256.9707
48	Construction	0	3.887737	0	183551.5625	0	447357.5313
58	Food Processing	0	0.018401	0	1413.930908	0	4734.411133
108	Textiles	0	0.032965	0	796.1908569	0	2940.559082
133	Logging Camps and Contractors	0	0.338334	0	19132.11914	0	53264.92969
134	Sawmills	234.832	33.03218	9189817	1292667.625	29114812	4095378
137	Wood Products	0	1.481187	0	56320.86328	0	135415.25
146	Pulp & Paper RWP	0	0.378994	0	40132.06641	0	110073.3047
150	Manufacturing	0	1.998587	0	107976.8516	0	325788.2188
433	Transportation	0	25.03626	0	1335980.75	0	2570524.25
441	Services	0	168.3413	0	6891674.5	0	9826164
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		234.832	261.1549	9189817	10434154.85	29114812	18413999.68

	Copyright MIG		IMPACT NAME: Sawmill Scenario 5 MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	32.16411	0	605062.0625	0	998643.375
28	Mining	0	0.119747	0	7041.671387	0	23363.86133
48	Construction	0	4.716865	0	222697.1719	0	542764.4375
58	Food Processing	0	0.022325	0	1715.476563	0	5744.10791
108	Textiles	0	0.039995	0	965.9926147	0	3567.685303
133	Logging Camps and Contractors	0	0.41049	0	23212.38086	0	64624.61719
134	Sawmills	284.914	40.07686	11149707	1568351.25	35324060	4968788
137	Wood Products	0	1.797076	0	68332.28125	0	164294.9375
146	Pulp & Paper RWP	0	0.459821	0	48690.94141	0	133548.3906
150	Manufacturing	0	2.424821	0	131004.8203	0	395268.3125
433	Transportation	0	30.37569	0	1620902.25	0	3118733.75
441	Services	0	204.243	0	8361446	0	11921767
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		284.914	316.8508	11149707	12659422.3	35324060	22341108.47

Wood Products, Northeast:

	Copyright MIG		IMPACT NAME: Wood Products Scenario 1	MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	1.013646	0	19068.4082	0	31472.04492
28	Mining	0	0.043197	0	2540.187256	0	8428.195313
48	Construction	0	0.495678	0	23402.42773	0	57037.12109
58	Food Processing	0	0.002812	0	216.1125641	0	723.6320801
108	Textiles	0	0.214623	0	5183.715332	0	19144.93359
133	Logging Camps and Contractors	0	0.063135	0	3570.137695	0	9939.470703
134	Sawmills	0	6.168503	0	241395.6563	0	764780.125
137	Wood Products	59.5074	1.187567	2262718.25	45156.21875	5440374	108571.5
146	Pulp & Paper RWP	0	0.197578	0	20921.77344	0	57383.75781
150	Manufacturing	0	0.793467	0	42868.33594	0	129342.5313
433	Transportation	0	2.78578	0	148654.3281	0	286021.75
441	Services	0	22.09149	0	904397.125	0	1289491.25
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		59.5074	35.05747	2262718.25	1457374.426	5440374	2762336.312

	Copyright MIG		IMPACT NAME: Wood Products Scenario 2	MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	1.822514	0	34284.61328	0	56586.09766
28	Mining	0	0.077667	0	4567.205078	0	15153.72363
48	Construction	0	0.891219	0	42077.08984	0	102551.5859
58	Food Processing	0	0.005057	0	388.5660095	0	1301.075806
108	Textiles	0	0.385888	0	9320.214844	0	34422.20313
133	Logging Camps and Contractors	0	0.113515	0	6419.035156	0	17870.9668
134	Sawmills	0	11.09084	0	434024.5	0	1375059.125
137	Wood Products	106.9931	2.135217	4068321.5	81189.82031	9781682	195209
146	Pulp & Paper RWP	0	0.355242	0	37616.92578	0	103174.8359
150	Manufacturing	0	1.426638	0	77076.39844	0	232555.25
433	Transportation	0	5.008777	0	267277.4688	0	514261.3125
441	Services	0	39.72004	0	1626087.625	0	2318479
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		106.9931	63.03262	4068321.5	2620329.462	9781682	4966624.176

Wood Products, Northeast:

	Copyright MIG		IMPACT NAME: Wood Products Scenario 3	MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	9.931677	0	186831.875	0	308362.4375
28	Mining	0	0.423244	0	24888.70117	0	82579.28125
48	Construction	0	4.856643	0	229296.5313	0	558848.5625
58	Food Processing	0	0.027557	0	2117.466553	0	7090.132324
108	Textiles	0	2.102873	0	50789.93359	0	187581.6563
133	Logging Camps and Contractors	0	0.618592	0	34980.13672	0	97386.73438
134	Sawmills	0	60.43887	0	2365189.75	0	7493300
137	Wood Products	583.0523	11.63574	22170068	442439.1563	53304672	1063780
146	Pulp & Paper RWP	0	1.935867	0	204991.0938	0	562244.875
150	Manufacturing	0	7.774377	0	420023.0938	0	1267295.5
433	Transportation	0	27.29502	0	1456512.125	0	2802435.25
441	Services	0	216.4519	0	8861264	0	12634408
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		583.0523	343.4924	22170068	14279323.86	53304672	27065312.43

	Copyright MIG		IMPACT NAME: Wood Products Scenario 4	MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	9.931677	0	186831.875	0	308362.4375
28	Mining	0	0.423244	0	24888.70117	0	82579.28125
48	Construction	0	4.856643	0	229296.5313	0	558848.5625
58	Food Processing	0	0.027557	0	2117.466553	0	7090.132324
108	Textiles	0	2.102873	0	50789.93359	0	187581.6563
133	Logging Camps and Contractors	0	0.618592	0	34980.13672	0	97386.73438
134	Sawmills	0	60.43887	0	2365189.75	0	7493300
137	Wood Products	583.0523	11.63574	22170068	442439.1563	53304672	1063780
146	Pulp & Paper RWP	0	1.935867	0	204991.0938	0	562244.875
150	Manufacturing	0	7.774377	0	420023.0938	0	1267295.5
433	Transportation	0	27.29502	0	1456512.125	0	2802435.25
441	Services	0	216.4519	0	8861264	0	12634408
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		583.0523	343.4924	22170068	14279323.86	53304672	27065312.43

Wood Products, Northeast:

Copyright MIG		IMPACT NAME: Wood Products Scenario 5 MULTIPLIER: Type SAM					
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	10.12622	0	190491.4688	0	314402.5313
28	Mining	0	0.431534	0	25376.21289	0	84196.8125
48	Construction	0	4.951773	0	233787.8906	0	569795.0625
58	Food Processing	0	0.028096	0	2158.942627	0	7229.01123
108	Textiles	0	2.144063	0	51784.78906	0	191255.9375
133	Logging Camps and Contractors	0	0.630709	0	35665.3125	0	99294.30469
134	Sawmills	0	61.62272	0	2411518.25	0	7640076
137	Wood Products	594.473	11.86365	22604326	451105.0938	54348784	1084616
146	Pulp & Paper RWP	0	1.973786	0	209006.3906	0	573257.9375
150	Manufacturing	0	7.926659	0	428250.3438	0	1292118.75
433	Transportation	0	27.82966	0	1485041.875	0	2857328.5
441	Services	0	220.6917	0	9034835	0	12881887
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		594.473	350.2206	22604326	14559021.57	54348784	27595457.85

Pulp and Paper, North Central:

IMPACT NAME: □Scenario1 MULTIPLIER: Type SAM							
Copyright MIG	2002						
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	-14.4	0	-287396	0	-676113
28	Mining	0	-0.2	0	-11488	0	-33845
48	Construction	0	-42.9	0	-1679814	0	-4537583
58	Food Processing	0	-0.1	0	-3892	0	-21110
108	Textiles	0	-0.3	0	-8710	0	-22849
133	Logging Camps and Contractors	0	-0.4	0	-22385	0	-63626
134	Sawmills	0	-29.3	0	-929274	0	-4548366
137	Wood Products	0	-3.2	0	-128333	0	-345984
146	Pulp & Paper RWP	-462.9	-4.5	-48851376	-478319	-134231600	-1314304
150	Manufacturing	0	-24.3	0	-1122289	0	-3255548
433	Transportation	0	-90.6	0	-3984433	0	-8205891
441	Services	0	-693.5	0	-25377336	0	-36170832
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-462.9	-903.9	-48851376	-34033669	-134231600	-59196050

Pulp and Paper, North Central:

IMPACT NAME: □Scenario2 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthCentral.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Indirect*	Induced*	Direct*	Indirect*
1	Agriculture	0	-5.6	-111971	-44118	0	-263418
28	Mining	0	-0.1	-4476	-808	0	-13186
48	Construction	0	-16.7	-654465	-107463	0	-1767869
58	Food Processing	0	0	-1516	-3087	0	-8224
108	Textiles	0	-0.1	-3394	-18558	0	-8902
133	Logging Camps and Contractors	0	-0.2	-8721	-44	0	-24789
134	Sawmills	0	-11.4	-362051	-1845	0	-1772070
137	Wood Products	0	-1.3	-49999	-8688	0	-134797
146	Pulp & Paper RWP	-180.3	-1.8	-186357	-25763	-52297420	-512064
150	Manufacturing	0	-9.5	-437250	-93138	0	-1268380
433	Transportation	0	-35.3	-1552359	-214942	0	-3197063
441	Services	0	-270.2	-9887159	-7862018	0	-14092368
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	-17053	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-180.3	-352.2	-13259718	-8397525	-52297420	-23063132
	37504						

IMPACT NAME: Scenario 3 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthCentral.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*
1	Agriculture	0	9.9	0	196811	0	463008
28	Mining	0	0.1	0	7867	0	23178
48	Construction	0	29.4	0	1150351	0	3107376
58	Food Processing	0	0.1	0	2665	0	14456
108	Textiles	0	0.2	0	5965	0	15647
133	Logging Camps and Contractors	0	0.3	0	15329	0	43572
134	Sawmills	0	20.1	0	636375	0	3114761
137	Wood Products	0	2.2	0	87883	0	236933
146	Pulp & Paper RWP	317	3.1	33453844	327561	91922960	900056
150	Manufacturing	0	16.7	0	768553	0	2229427
433	Transportation	0	62.1	0	2728574	0	5619465
441	Services	0	474.9	0	17378618	0	24770098
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		317	619	33453844	23306553	91922960	40537976

Pulp and Paper, North Central:

	37502						
IMPACT NAME:Scenario4 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthCentral.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Direct*	Indirect*	Direct*	Indirect*
1	Agriculture	0	20.9	0	416022	0	978714
28	Mining	0	0.3	0	16630	0	48993
48	Construction	0	62.1	0	2431630	0	6568421
58	Food Processing	0	0.1	0	5634	0	30557
108	Textiles	0	0.5	0	12609	0	33076
133	Logging Camps and Contractors	0	0.6	0	32403	0	92102
134	Sawmills	0	42.4	0	1345180	0	6584030
137	Wood Products	0	4.7	0	185769	0	500832
146	Pulp & Paper RWP	670	6.6	70715264	692400	194308208	1902544
150	Manufacturing	0	35.2	0	1624579	0	4712598
433	Transportation	0	131.2	0	5767704	0	11878514
441	Services	0	1003.9	0	36735196	0	52359424
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		670	1308.5	70715264	49265756	194308208	85689805
	37502						
IMPACT NAME: □Scenario5 MULTIPLIER: Type SAM							
Copyright MIG	2002	NorthCentral.iap					
		Employ	Employ	VA	VA	Output	Output
	Industry	Direct*	Indirect*	Indirect*	Induced*	Direct*	Indirect*
1	Agriculture	0	59.7	1189226	468569	0	2797716
28	Mining	0	0.7	47538	8580	0	140051
48	Construction	0	177.6	6950970	1141346	0	18776248
58	Food Processing	0	0.4	16104	32787	0	87350
108	Textiles	0	1.3	36043	197104	0	94549
133	Logging Camps and Contractors	0	1.7	92627	468	0	263281
134	Sawmills	0	121.2	3845282	19593	0	18820868
137	Wood Products	0	13.4	531034	92272	0	1431661
146	Pulp & Paper RWP	1915.3	18.8	1979263	273627	555442368	5438528
150	Manufacturing	0	100.7	4643963	989208	0	13471261
433	Transportation	0	374.9	16487348	2282863	0	33955488
441	Services	0	2869.9	105009896	83501216	0	149672736
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	181121	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		1915.3	3740.3	140829293	89188753	555442368	244949736

Sawmills, North Central:

			North Central				
	Copyright MIG		IMPACT NAME: Sawmill Scenario 1		MULTIPLIER: Type SAM		
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	0.137588	0	2742.360352	0	6451.54541
28	Mining	0	2.57E-05	0	1.678245783	0	4.944263935
48	Construction	0	0.012953	0	506.8669739	0	1369.170166
58	Food Processing	0	3.87E-05	0	1.494186878	0	8.104631424
108	Textiles	0	0.000105	0	2.822661161	0	7.404409409
133	Logging Camps and Contractors	0	0.000675	0	36.77961731	0	104.5412064
134	Sawmills	0.371602	0.048109	11792.74512	1526.719604	57720	7472.582031
137	Wood Products	0	0.003611	0	143.0169983	0	385.5722656
146	Pulp & Paper RWP	0	0.0009	0	95.02089691	0	261.0941162
150	Manufacturing	0	0.004153	0	191.4831543	0	555.456543
433	Transportation	0	0.069804	0	3069.490723	0	6321.578125
441	Services	0	0.419456	0	15348.20605	0	21876.10938
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		0.371602	0.697417	11792.74512	23665.93947	57720	44818.10254
	Copyright MIG		IMPACT NAME: Sawmill Scenario 2		MULTIPLIER: Type SAM		
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	-0.007385	0	-147.1904449	0	-346.2731628
28	Mining	0	-1.38E-06	0	-0.09007632	0	-0.265372992
48	Construction	0	-0.000695	0	-27.2050209	0	-73.48733521
58	Food Processing	0	-2.08E-06	0	-0.080197349	0	-0.434999108
108	Textiles	0	-5.62E-06	0	-0.151500419	0	-0.397416145
133	Logging Camps and Contractors	0	-3.62E-05	0	-1.97406888	0	-5.611030102
134	Sawmills	-0.019945	-0.002582	-632.9508667	-81.94347382	-3098	-401.0751953
137	Wood Products	0	-0.000194	0	-7.676136971	0	-20.69478226
146	Pulp & Paper RWP	0	-4.83E-05	0	-5.100047588	0	-14.0136795
150	Manufacturing	0	-0.000223	0	-10.27745724	0	-29.8129673
433	Transportation	0	-0.003747	0	-164.7484894	0	-339.2974548
441	Services	0	-0.022513	0	-823.7827759	0	-1174.154297
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-0.019945	-0.037432	-632.9508667	-1270.21969	-3098	-2405.517692

Sawmills, North Central:

	Copyright MIG		IMPACT NAME: Sawmill Scenario 3 MULTIPLIER: Type SAM					
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	43.64865	0	869993.8125	0	2046705.625
28	Mining	0	0.008138	0	532.4111938	0	1568.531494
48	Construction	0	4.10931	0	160799.8438	0	434359.2188
58	Food Processing	0	0.012265	0	474.0198975	0	2571.135254
108	Textiles	0	0.033214	0	895.4685669	0	2348.994629
133	Logging Camps and Contractors	0	0.214095	0	11668.06445	0	33164.93359
134	Sawmills	117.8879	15.26208	3741162	484340.625	18311248	2370622
137	Wood Products	0	1.145465	0	45371.09766	0	122319.9844
146	Pulp & Paper RWP	0	0.285622	0	30144.68555	0	82830.20313
150	Manufacturing	0	1.317464	0	60746.63281	0	176214.5313
433	Transportation	0	22.14465	0	973773.5	0	2005474.375
441	Services	0	133.0694	0	4869106	0	6940035.5
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		117.8879	221.2504	3741162	7507846.161	18311248	14218215.03

	Copyright MIG		IMPACT NAME: Sawmill Scenario 4 MULTIPLIER: Type SAM					
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	51.67883	0	1030049.188	0	2423244.25
28	Mining	0	0.009635	0	630.3605347	0	1857.099121
48	Construction	0	4.865312	0	190382.6719	0	514269.5938
58	Food Processing	0	0.014521	0	561.2267456	0	3044.154785
108	Textiles	0	0.039325	0	1060.210693	0	2781.146484
133	Logging Camps and Contractors	0	0.253483	0	13814.67383	0	39266.38672
134	Sawmills	139.5761	18.06989	4429435	573446.125	21680024	2806752
137	Wood Products	0	1.356199	0	53718.15625	0	144823.5625
146	Pulp & Paper RWP	0	0.338169	0	35690.49609	0	98068.72656
150	Manufacturing	0	1.559842	0	71922.38281	0	208633.2656
433	Transportation	0	26.21868	0	1152921.625	0	2374427.75
441	Services	0	157.5506	0	5764890	0	8216815
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		139.5761	261.9545	4429435	8889087.116	21680024	16833982.94

Sawmills, North Central:

	Copyright MIG		IMPACT NAME: Sawmill Scenario 5 MULTIPLIER: Type SAM					
Industry		Employ Direct*	Employ Indirect*	VA Direct*	Va Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	64.70549	0	1289693.125	0	3034070
28	Mining	0	0.012064	0	789.255127	0	2325.217041
48	Construction	0	6.091709	0	238372.3281	0	643901.25
58	Food Processing	0	0.018182	0	702.6948853	0	3811.493164
108	Textiles	0	0.049237	0	1327.457397	0	3482.188477
133	Logging Camps and Contractors	0	0.317378	0	17296.93164	0	49164.24219
134	Sawmills	174.759	22.62475	5545960.5	717994.25	27144896	3514248
137	Wood Products	0	1.698056	0	67258.85938	0	181329.1563
146	Pulp & Paper RWP	0	0.423411	0	44686.98047	0	122788.8594
150	Manufacturing	0	1.953031	0	90051.8125	0	261223.3281
433	Transportation	0	32.8276	0	1443537.875	0	2972948.25
441	Services	0	197.2643	0	7218043	0	10288023
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		174.759	327.9852	5545960.5	11129754.57	27144896	21077314.98

Wood Products, North Central:

			IMPACT NAME: Wood Products Scenario 1 MULTIPLIER: Type SAM				
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	-0.595107	0	-11861.51855	0	-27904.83789
28	Mining	0	-0.001166	0	-76.29044342	0	-224.7585449
48	Construction	0	-0.1799	0	-7039.617676	0	-19015.70898
58	Food Processing	0	-0.000396	0	-15.30671978	0	-83.0253067
108	Textiles	0	-0.049532	0	-1335.411377	0	-3503.053223
133	Logging Camps and Contractors	0	-0.014867	0	-810.2521362	0	-2303.034668
134	Sawmills	0	-1.06009	0	-33641.85156	0	-164661.2188
137	Wood Products	-12.96025	-0.217226	-513347.0313	-8604.169922	-1383978	-23196.75
146	Pulp & Paper RWP	0	-0.053477	0	-5643.940918	0	-15508.16504
150	Manufacturing	0	-0.165881	0	-7648.566895	0	-22187.05078
433	Transportation	0	-0.8942	0	-39320.91406	0	-80980.9375
441	Services	0	-6.23984	0	-228320.1719	0	-325429.375
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-12.96025	-9.471682	-513347.0313	-344318.0121	-1383978	-684997.9157

Wood Products, North Central:

	Copyright MIG		IMPACT NAME: Wood Products Scenario 2		MULTIPLIER: Type SAM			
Industry		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	-0.904956	0	-18037.35352	0	-42433.8125
28	Mining	0	-0.001773	0	-116.0119476	0	-341.7816772
48	Construction	0	-0.273568	0	-10704.87598	0	-28916.45703
58	Food Processing	0	-0.000602	0	-23.27633858	0	-126.2533875
108	Textiles	0	-0.075322	0	-2030.708496	0	-5326.958008
133	Logging Camps and Contractors	0	-0.022608	0	-1232.119263	0	-3502.13623
134	Sawmills	0	-1.612038	0	-51157.86719	0	-250393.9688
137	Wood Products	-19.70816	-0.330328	-780627	-13084.06641	-2104562	-35274.5
146	Pulp & Paper RWP	0	-0.08132	0	-8582.523438	0	-23582.66992
150	Manufacturing	0	-0.252249	0	-11630.88086	0	-33738.99219
433	Transportation	0	-1.359775	0	-59793.80078	0	-123144.5938
441	Services	0	-9.488684	0	-347197.6875	0	-494867.9375
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		-19.70816	-14.40322	-780627	-523591.1717	-2104562	-1041650.061

	Copyright MIG		IMPACT NAME: Wood Products Scenario 3		MULTIPLIER: Type SAM		
		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	29.30779	0	584155.3125	0	1374255.75
28	Mining	0	0.057427	0	3757.147217	0	11068.89551
48	Construction	0	8.859729	0	346686.6875	0	936484.5
58	Food Processing	0	0.019505	0	753.8244629	0	4088.825439
108	Textiles	0	2.43937	0	65766.25781	0	172518.1563
133	Logging Camps and Contractors	0	0.732176	0	39903.24609	0	113419.7109
134	Sawmills	0	52.20724	0	1656791.875	0	8109225.5
137	Wood Products	638.2658	10.69792	25281282	423737.625	68158064	1142392
146	Pulp & Paper RWP	0	2.633609	0	277952.4688	0	763745.1875
150	Manufacturing	0	8.169297	0	376676.1563	0	1092666.5
433	Transportation	0	44.0375	0	1936474	0	3988144.25
441	Services	0	307.2992	0	11244298	0	16026726
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		638.2658	466.4608	25281282	16956952.6	68158064	33734735.28

Wood Products, North Central:

	Copyright MIG		IMPACT NAME: Wood Products Scenario 4		MULTIPLIER: Type SAM			
		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	30.10946	0	600134.0625	0	1411846.625
28	Mining	0	0.058998	0	3859.918457	0	11371.66895
48	Construction	0	9.102075	0	356169.8125	0	962100.75
58	Food Processing	0	0.020038	0	774.4442139	0	4200.669434
108	Textiles	0	2.506095	0	67565.19531	0	177237.1406
133	Logging Camps and Contractors	0	0.752204	0	40994.74609	0	116522.1484
134	Sawmills	0	53.6353	0	1702111.125	0	8331042
137	Wood Products	655.7247	10.99055	25972816	435328.1563	70022432	1173640
146	Pulp & Paper RWP	0	2.705648	0	285555.4688	0	784636.375
150	Manufacturing	0	8.392757	0	386979.5938	0	1122554.875
433	Transportation	0	45.24208	0	1989443.5	0	4097234.25
441	Services	0	315.705	0	11551870	0	16465115
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		655.7247	479.2202	25972816	17420786.02	70022432	34657501.5

	Copyright MIG		IMPACT NAME: Wood Product Scenario 5		MULTIPLIER: Type SAM		
		Employ Direct*	Employ Indirect*	VA Direct*	VA Indirect*	Output Direct*	Output Indirect*
1	Agriculture	0	39.32132	0	783742.5	0	1843795
28	Mining	0	0.077048	0	5040.844238	0	14850.7832
48	Construction	0	11.88682	0	465138.4688	0	1256451.375
58	Food Processing	0	0.026169	0	1011.382141	0	5485.846191
108	Textiles	0	3.272825	0	88236.48438	0	231462.0938
133	Logging Camps and Contractors	0	0.982337	0	53536.91406	0	152171.6094
134	Sawmills	0	70.04479	0	2222864.75	0	10879889
137	Wood Products	856.3408	14.35307	33919088	568515.625	91445496	1532712
146	Pulp & Paper RWP	0	3.533429	0	372919.9375	0	1024692.5
150	Manufacturing	0	10.96049	0	505374.375	0	1465995.75
433	Transportation	0	59.08371	0	2598105.25	0	5350765.5
441	Services	0	412.2935	0	15086115	0	21502546
524	Rest Of The World Industry	0	0	0	0	0	0
525	Domestic Services	0	0	0	0	0	0
526	Dummy	0	0	0	0	0	0
527	Dummy	0	0	0	0	0	0
528	Inventory Valuation Adjustment	0	0	0	0	0	0
25001	Foreign Trade	0	0	0	0	0	0
28001	Domestic Trade	0	0	0	0	0	0
		856.3408	625.8356	33919088	22750601.53	91445496	45260817.46

PowerPoint Slides

University of Minnesota Duluth
School of Business and Economics
Bureau of Business and Economic Research
Research Report

Forestry Bottleneck Analysis

September 2002

Minnesota Forest Resources Council

The UMD Bureau of Business and Economic Research (BBER) was asked to

1. **Analyze possible bottlenecks to wood products production**
   - **when the supply of appropriate species of trees are not available.**

2. **Develop a new input-output hybrid model**
   - **that combines physical quantities with monetary quantities.**

3. **Make scenario runs based on Council suggestions.**

Minnesota Forest Resources Council

UMD DULUTH BUREAU OF BUSINESS AND ECONOMIC RESEARCH

With these slides we present:

1) **Project purpose**
2) **Source Data and Methodology**
3) **Findings**
4) **What this might mean for policy makers**

1) What we wanted to find out

Project deliverable

A detailed report showing:

- **where there are impacts from supply bottlenecks to production**
- **based on the changes in wood supply and species mix due to ecological considerations.**

1) What this report does not cover

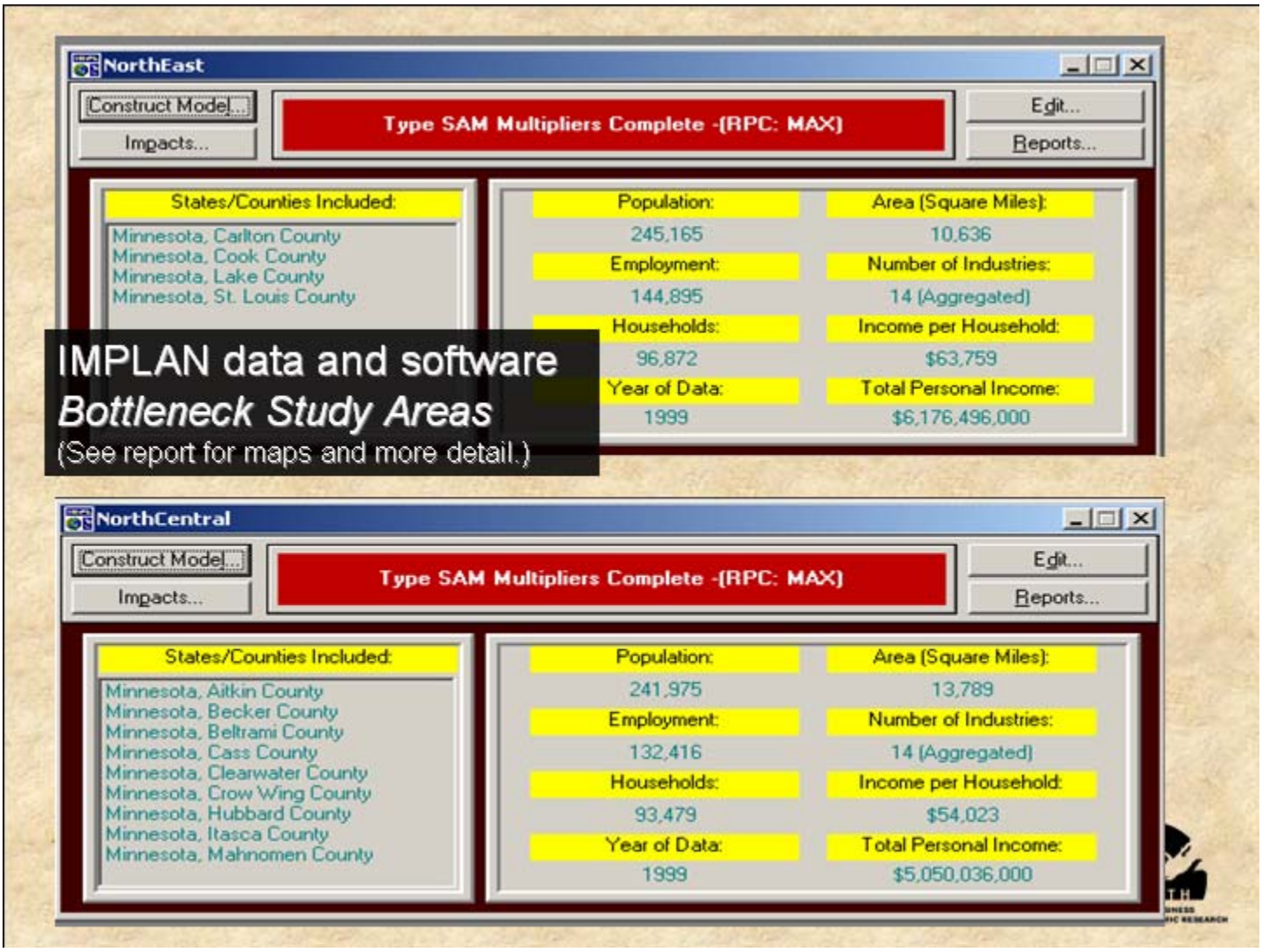
- **alternatives relative to land use, for instance tourism vs. other commercial uses of the forest.**
- **the benefits and costs of alternative land uses.**
- **We are did not estimate tree supply – this was provided by the Council.**
- **social/environmental impacts.**
- **Although we report bottlenecks for the combined region, we did not report specific IMPLAN impacts for the regions combined, because for this model the impacts of the two regions do not equal the impact of a combined region.**
- **We did not estimate wood imports and exports separately. IMPLAN estimates imports and exports and these values were used as givens of the model**

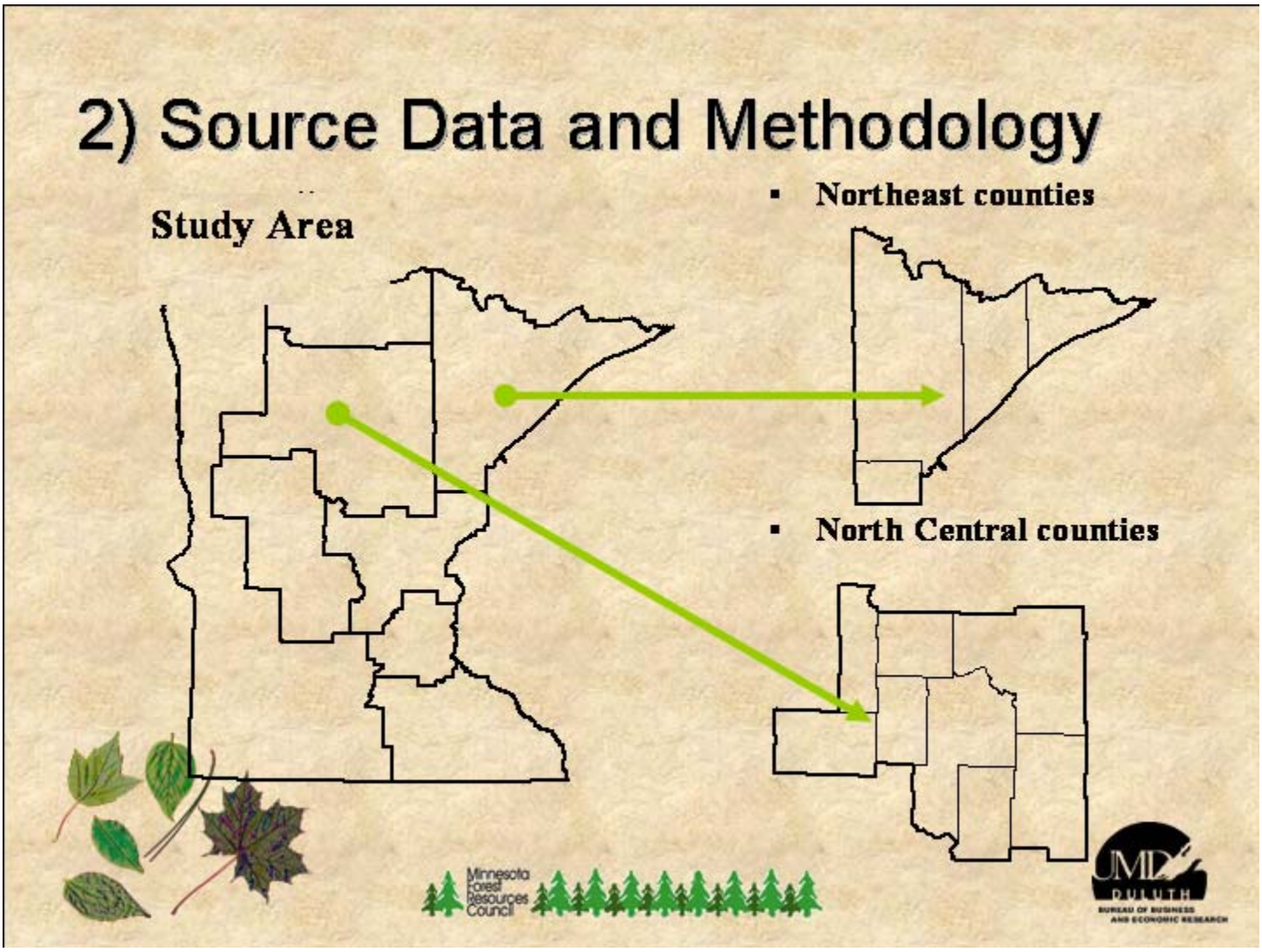
2) Source Data and Methodology

- **Inputs from Regional Committees of the MFRC**
- **IMPLAN data**

2) Source Data and Methodology

- **Input data used in the IMPLAN model was developed for the MFRC Northeast and North Central landscapes.**
  - **estimating the harvest levels of 1999 and growth from 1990.**
- **Inputs for the future scenarios are estimated by professional judgment and FIA growth estimates (cords/acre).**


NorthEast
Construct Model...
Impacts...
Type SAM Multipliers Complete -(RPC: MAX)
Edit...
Reports...
States/Counties Included:
Minnesota, Carlton County
Minnesota, Cook County
Minnesota, Lake County
Minnesota, St. Louis County
Population:
245,165
Area (Square Miles):
10,636
Employment:
144,895
Number of Industries:
14 (Aggregated)
Households:
96,872
Income per Household:
$63,759
Year of Data:
1999
Total Personal Income:
$6,176,496,000
IMPLAN data and software
Bottleneck Study Areas
(See report for maps and more detail.)
NorthCentral
Construct Model...
Impacts...
Type SAM Multipliers Complete -(RPC: MAX)
Edit...
Reports...
States/Counties Included:
Minnesota, Aitkin County
Minnesota, Becker County
Minnesota, Beltrami County
Minnesota, Cass County
Minnesota, Clearwater County
Minnesota, Crow Wing County
Minnesota, Hubbard County
Minnesota, Itasca County
Minnesota, Mahnomen County
Population:
241,975
Area (Square Miles):
13,789
Employment:
132,416
Number of Industries:
14 (Aggregated)
Households:
93,479
Income per Household:
$54,023
Year of Data:
1999
Total Personal Income:
$5,050,036,000


2) Source Data and Methodology
Study Area
Northeast counties
North Central counties
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2) Source Data and Methodology

How we found answers

Important input-output model assumptions:

When one industry in a defined region increases its production, the supply of intermediate products needed in production will be available.

Note: This analysis assumes industries are at full capacity and that there will be no change in productivity or technology.

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2) Source Data and Methodology

- **IMPLAN (Impact Analysis for Planning)**
- **Software system built for the U.S. Forest Service**
  - **From Ft. Collins (Colorado State)**
  - **Then in University of Minnesota department of Applied Economics**
  - **Now a private, Minnesota corporation – IMPLAN User's Group http://www.implan.com**
  - **We use Access data base software to make needed changes**

(See report for more details.)

2) Source Data and Methodology

Forecasting Model

Input-output breaks region into industries

1. traces economic interactions between industries
   - intermediate product purchases and sales
   - between these industries, resource owners, final demand.
2. IMPLAN identified dollar transactions.
3. BBER exported dollar transactions to Excel
4. BBER developed a model including industry interactions (cords of tree species).

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(See report for more details.)

2) Source Data and Methodology

Input-Output Model → Hybrid Model

- **Both models create *multipliers* which are used against changes in final demand, or dollar demand by final users.**
- **However, in the hybrid model case, some of these multipliers are in terms of physical units, in this case, cords.**

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2) Source Data and Methodology

Input-Output Industries

For this analysis, industries were categorized into a special aggregation:

- **Agriculture**
- **Mining**
- **Construction**
- **Food Processing**
- **Textiles**
- **Logging Camps and Logging Contractors**
- **Sawmills**
- **Wood Products**
- **Pulp & Paper RWP**
- **Manufacturing**
- **Transportation**
- **Services**
- **Rest of the World Industry**
- **Domestic Services**

3) What answers we found

For 1999 and five scenarios

- **Supply Bottlenecks**
- **Impacts of the supply bottlenecks**
- **Sensitivity Analyses**

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Note: Source Data on regions includes

(See report for more details.)

- **Volumes in cords**
  - **for tree species groups**
  - **for regions**
  - **for scenarios 1-5**

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3) Findings

(See report for more details.)

Five Scenarios, Two Regions
Plus Combined Region

- **Region scenario definitions**
- **Sensitivity analyses**
- **Bottlenecks (Supply and Demand)**
- **IMPLAN impacts (% changes, employment, value added, output)**

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3) Findings

(See report for more details.)

Scenario Definitions

NORTHEAST REGION

Scenario 1	**Developed by *ad hoc* groups moving toward landscape desired forest conditions.**
Scenario 2	**Harvest levels are above scenario 1 for the next 10-20 yrs then decline; landscape still move the landscape desired forest conditions.**
Scenario 3	**Total growth minus mortality based on 1990 FIA data.**
Scenario 4	**Total growth minus 50% of the mortality based on 1990 FIA data.**
Scenario 5	**Harvests all annual growth for all species; assumes all mortality is captured.**

Source: MFRC

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3) Findings

(See report for more details.)

Scenario Definitions

NORTH CENTRAL REGION

Scenario 1	**Moves landscape toward desired forest conditions using MIN RNV as guide; used in place of the Skally scenario because they were so similar.**
Scenario 2	**Developed by the Adams group; moves the landscape toward desired forested conditions.**
Scenario 3	**This is total growth minus mortality using 1990 FIA data.**
Scenario 4	**Total growth minus 50% of the mortality based on 1990 FIA data.**
Scenario 5	**Harvests all annual growth for all species; assumes all mortality is captured.**

Source: MFRC

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3) Findings

(See report for more details.)

Sensitivity Analyses

- **BBER was asked to do analysis for:**
  - **Baseline data**
  - **1% Decrease**
  - **1% Increase**
  - **10% Decrease**
  - **10% Increase**

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3) Findings

(See report for more details.)

Bottlenecks (Supply and Demand) *Note grey cells as "bottlenecks"*

Northeast Minnesota: Pulp and Paper, Sawmills Bottleneck Supply and Demand

			Scenario 1		*Scenario 2*		*Scenario 3*		*Scenario 4*		*Scenario 5*	
	Tree Species	***DEMAND for all scenarios***	***Supply***	***Supply Minus Demand***	***Supply***	***Supply Minus Demand***	***Supply***	***Supply Minus Demand***	***Supply***	***Supply Minus Demand***	***Supply***	***Supply Minus Demand***
Pulp & Paper	Balsam Fir	**72259**	67627	(4632)	76448	4189	98010	25751	212682	140423	328334	256075
	White Birch	**73846**	127057	53211	140867	67021	128898	55052	176774	102928	224651	150805
	Maple	**4927**	10890	5963	15840	10913	55440	50513	57420	52493	59400	54473
	Aspen	**549756**	320493	(229263)	353816	(195940)	462607	(87149)	612563	62807	762518	212762
	Mixed Hardwoods	**13297**	12355	(942)	18058	4761	127354	114057	149213	135916	171072	157775
	Red Pine	**17572**	19325	1753	21740	4168	45896	28324	45896	28324	46500	28928
	White Pine	**1812**	594	(1218)	594	(1218)	15444	13632	16335	14523	17226	15414
	Jack Pine	**33535**	21899	(11636)	24245	(9290)	16424	(17111)	33630	95	51619	18084
	Mixed Softwoods	**74776**	31690	(43086)	37452	(37324)	283289	208513	342827	268051	404286	329510
	TOTAL	**841779**	611930	(229849)	689060	(152719)	1233362	391583	1647340	805561	2065606	1223827
Sawmills	Balsam Fir	**2489**	683	(1806)	772	(1717)	990	(1499)	2148	(341)	3317	828
	White Birch	**3867**	9563	5697	10603	6736	9702	5835	13306	9439	16909	13043
	Maple	**156**	0	(156)	0	(156)	0	(156)	0	(156)	0	(156)
	Aspen	**18935**	3237	(15697)	3574	(15361)	4673	(14262)	6188	(12747)	7702	(11232)
	Mixed Hardwoods	**574**	515	(59)	752	179	5306	4733	6217	5644	7128	6554
	Red Pine	**3298**	11722	8423	13187	9889	27839	24541	27839	24541	28205	24907
	White Pine	**1013**	1386	373	1386	373	36036	35023	38115	37102	40194	39181
	Jack Pine	**3471**	5821	2350	6445	2974	4366	895	8940	5469	13721	10251
	Mixed Softwoods	**3006**	980	(2025)	1158	(1847)	8762	5756	10603	7597	12504	9498
	TOTAL	**36808**	33908	(2900)	37877	1070	97673	60866	113355	76547	129680	92872

Note: Specialty Woods impact numbers are very small. The details are shown in the report.

3) Findings

(See report for more details.)

Bottlenecks (Supply and Demand) *Note grey cells as "bottlenecks"*

North Central Minnesota: Pulp and Paper, Sawmills Bottleneck Supply and Demand

	Tree Species	*DEMAND for all scenarios*	*Supply*	*Supply Minus Demand*	*Supply*	*Supply Minus Demand*	*Supply*	*Supply Minus Demand*	*Supply*	*Supply Minus Demand*	*Supply*	*Supply Minus Demand*
Pulp & Paper	Balsam Fir	65,559	63,063	(2,496)	65,003	(556)	78,586	13,027	140,679	75,120	202,772	137,213
	White Birch	81,402	78,062	(3,340)	79,943	(1,459)	134,492	53,090	186,219	104,817	237,006	155,604
	Maple	519	505	(14)	505	(14)	38,877	38,358	40,897	40,378	42,917	42,398
	Aspen	1,042,053	775,544	(266,509)	943,046	(99,007)	742,625	(299,428)	744,561	(297,492)	1,234,481	192,428
	Mixed Hardwoods	26,380	25,502	(878)	25,502	(878)	234,986	208,606	281,437	255,057	328,799	302,419
	Red Pine	44,280	43,065	(1,215)	40,590	(3,690)	89,100	44,820	90,090	45,810	91,575	47,295
	White Pine	908	792	(116)	792	(116)	4,950	4,042	5,148	4,240	5,445	4,537
	Jack Pine	63,375	66,429	3,054	63,162	(213)	50,094	(13,281)	51,183	(12,192)	87,665	24,290
	Mixed Softwoods	41,048	41,293	245	41,293	245	177,656	136,608	217,988	176,940	257,360	216,312
	TOTAL	1,365,524	1,094,255	(271,269)	1,259,836	(105,688)	1,551,366	185,842	1,758,202	392,678	2,488,020	1,122,496
Sawmills	Balsam Fir	5,853	1,287	(4,566)	1,327	5,893	1,604	(4,249)	2,871	(2,982)	4,138	(1,715)
	White Birch	7,849	4,109	(3,740)	4,208	7,948	7,079	(770)	9,801	1,952	12,474	4,625
	Maple	151	485	334	485	151	37,353	37,202	39,293	39,142	41,234	41,083
	Aspen	93,172	15,860	(77,312)	19,285	96,597	15,187	(77,985)	15,226	(77,946)	25,245	(67,927)
	Mixed Hardwoods	8,834	29,938	21,103	29,938	8,834	275,854	267,019	330,383	321,549	385,981	377,147
	Red Pine	11,786	37,036	25,250	34,907	9,657	76,626	64,840	77,477	65,692	78,755	66,969
	White Pine	1,452	7,128	5,676	7,128	1,452	44,550	43,098	46,332	44,880	49,005	47,553
	Jack Pine	16,287	53,143	36,856	50,530	13,673	40,075	23,788	40,946	24,659	70,132	53,845
	Mixed Softwoods	3,761	1,277	(2,484)	1,277	3,761	5,495	1,734	6,742	2,981	7,960	4,199
	TOTAL	149,144	150,262	1,118	149,084	147,966	503,821	354,677	569,072	419,928	674,923	525,779

Note: Specialty Woods impact numbers are very small. The details are shown in the report.

3) Findings

(See report for more details.)

Bottlenecks

(Tracking Tree Species Supply and Demand)

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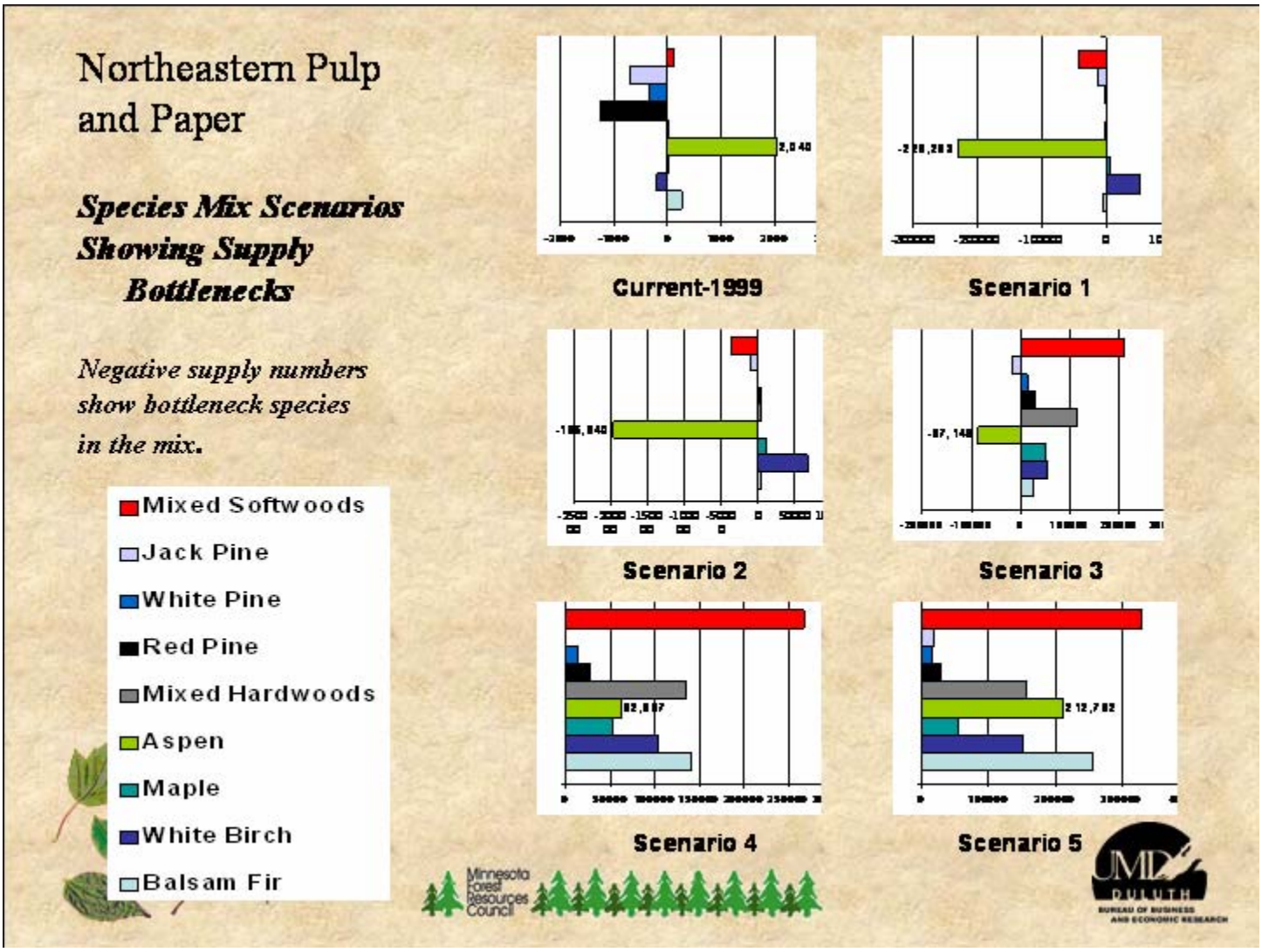
Northeastern Pulp and Paper
Species Mix Scenarios Showing Supply Bottlenecks
Negative supply numbers show bottleneck species in the mix.
Mixed Softwoods
Jack Pine
White Pine
Red Pine
Mixed Hardwoods
Aspen
Maple
White Birch
Balsam Fir
Current-1999
Scenario 1
Scenario 2
Scenario 3
Scenario 4
Scenario 5
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3) Findings

(See report for more details.)

More analysis

- **From the models and data we can also calculate detailed reports such as employment impacts for specific industries.**

3) Findings

(See report for more details.)

More analysis

Northeast employment % change for scenarios

Employment Impacts from IMPLAN
Northeast Region

	Change in Direct Employment	% change Sector	Change in Indirect Employment	% change Region
Pulp & Paper RWP Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	2,039	Total Region Employment =	144,895
Scenario 1	-520	-25.5%	-981	-0.7%
Scenario 2	-345	-16.9%	-652	-0.4%
Scenario 3	885	43.4%	1670	1.2%
Scenario 4	1822	89.3%	3436	2.4%
Scenario 5	2767	135.7%	5220	3.6%
Sawmills Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	517	Total Region Employment =	144,895
Scenario 1	-9	-1.7%	-10	0.0%
Scenario 2	3	0.6%	4	0.0%
Scenario 3	187	36.1%	208	0.1%
Scenario 4	235	45.4%	261	0.2%
Scenario 5	285	55.1%	317	0.2%
Specialty Woods Impact				
Note: Compare % relative to these totals:	Total Sector Employment =	573	Total Region Employment =	144,895
Scenario 1	60	10.4%	35	0.0%
Scenario 2	107	18.7%	63	0.0%
Scenario 3	583	101.8%	344	0.2%
Scenario 4	583	101.8%	344	0.2%
Scenario 5	595	103.8%	350	0.2%

(See report for more details.)

3) Findings

More analysis

The same calculations have been run for Value Added and Output impacts, and are available in the full report.

For example, NE Pulp and Paper, Direct Value Added, Scenario 1, drops $55 million or 25.5% from the baseline 1999 level.

Or, for example, North Central Sawmill, Direct Output increases $18.3 million or 30.3% in Scenario 3 from 1999 baseline level.

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4) So What? What this means for policy makers

1. **We have a model to use for more applications, more scenarios.**
2. **We have a range of numbers for "big picture" discussions and long-term planning.**

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4) So What? What this means for policy makers

We have a model to use for more applications, more scenarios. How good are these numbers?

Mitigating factors:

- **Pricing, Markets, Transportation Costs**

Import/Export picture:

- **Exports are a part of final demand**
- **Imports are a part of final payments**
- **Final payments affect size of multipliers**
- **Final demand does not**
- **Pulp and paper, sawmills, and miscellaneous take exports and imports into account; logging does not (physical units), unless data are available**

4) So What? What this means for policy makers

<u>We have a range of numbers</u> for "big picture" discussions and long-term planning

- **This model has flexibility**
- **The numbers are the best we can get:**
  - **The information is based on 1999 data, technology, and productivity.**
- **These numbers confirm that for long-term planning, GEIS analysis *can* be used to shape the landscape, when planning includes *consequences from the large impact that forest products have* on the economy of the region and the state.**

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