

Chapter 5 - Outlook for U.S. paper and paperboard sector and Wood fiber supply in North America

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Abstract.

Consumption of wood fiber in pulp, paper and paperboard increased in the United States over the past century and is projected to increase well into the next century at a decelerating rate of growth. Harvest of pulpwood on forest land is the single largest source of wood fiber, followed by recycled paper and wood residues. In the past decade, wood residues declined in supply while use of recycled paper increased rapidly. Use of recycled paper is projected to increase more steadily in the future with slower growth in paper recovery for recycling. Harvest of pulpwood on forest land is projected to remain the dominant source of U.S. fiber supply through the first half of the next century. Softwood pulpwood harvest on forest land is projected to increase as U.S. softwood residue supplies decline. Pulpwood stumpage values are projected to increase in the United States, based on supply and demand analysis, gradually improving economic opportunities for growing hardwood short-rotation woody crops on agricultural land. Hardwood pulpwood harvest on forest land is projected to increase for several decades but then decline in the long run with increasing fiber supply from agricultural short-rotation woody crops. Canada is projected to remain the principal source of U.S. pulp and paper imports, which are projected to increase. Most Canadian domestic pulpwood supply is projected to remain wood residues, as Canadian lumber production and residue output are projected to increase in the future. Pulpwood harvest in Canada is projected to decrease with modest additional increases in paper recycling.

KEY WORDS. Pulp and Paper, Wood Fiber Markets, Technology, Pulpwood

Context of analysis

The United States Forest Service has published periodic national assessments of the forest and rangeland situation in the United States under guidelines of the Forest and Rangeland Renewable Resources Planning Act of 1974 ("RPA"). Recent assessments include the 1989 RPA Assessment (Forest Service 1989) and 1993 RPA Assessment Update (Forest Service 1994). RPA resource assessments have been supported by comprehensive economic analyses of the timber supply-demand situation in the United States. Recent EVA timber analyses include the 1979 RPA analysis of the timber situation (Forest Service 1982), the 1989 EVA analysis of the timber situation (Haynes 1990), and the 1993 RPA timber assessment update (Haynes et al. 1995).

In recent RPA timber assessments, analysis of pulpwood supply and demand has been facilitated by an economic model known as the North American Pulp and Paper (NAPAP) Model. The NAPAP Model is a comprehensive economic model of the U.S. and Canadian pulp and paper sectors, developed jointly by U.S. Forest Service, Forestry Canada, and University of Wisconsin (Ince 1994). The NAPAP model simulates competitive evolution of production in the pulp and paper sector by principal product, process and region in North America, computing annual product market equilibria, projected trade flows, and evolution in fiber supply and demand. The model produces fairly accurate projections of trends in paper recycling and production by process and regions. The NAPAP Model was developed further in recent years, resulting in a new version of the model known as the "1998 NAPAP Model", results of which are presented in this paper.

The 1998 NAPAP Model is a partial equilibrium economic model of the North American pulp and paper sector, similar to the earlier NAPAP Model (Ince 1994, Zhang et al. 1995). The 1998 NAPAP Model is an application of the price-endogenous linear programming system known as "PELPS" that was developed for economic modelling at the University of Wisconsin and Forest Products Laboratory (Zhang et al. 1994). The model is run in conjunction with the Forest Service TAMM/ATLAS model, which computes equilibrium trends in lumber and wood panel markets and projects timber growth. The 1998 NAPAP Model has been carefully tested against historical trends and the model computes fairly accurate annual production and market equilibria from a base year of 1986 to the present. Thus, model projections are validated in part by the model's ability to track actual historical market equilibria and technological trends of the recent past. Some of the charts in this paper show how accurately the model tracks annual production and market equilibria of the past decade.

Outlook for U.S. paper and paperboard demand

An integral part of the NAPAP Model is analysis of demand equilibria for paper and paperboard products in North America, including U.S. and Canadian domestic demands and export demands. U.S. demands are by far the largest component of paper and paperboard demands in North America, and therefore U.S. population and economic growth assumptions are crucial in the analysis. As shown in figure 1, slower but steady U.S. population growth is assumed (based on Census Bureau projections) along with increasing Gross Domestic Product (GDP) per capita. Paper and paperboard demand functions in the NAPAP Model are related to population and per capita GDP, historically good predictors of paper and paperboard demands. Demand functions are also modulated by elasticities with respect to price trends in plastic and electronic substitutes (Zhang 1995).

As shown in figure 2, growth in per capita paper and paperboard consumption is projected to gradually decelerate in the future, as markets for most paper and paperboard commodities are maturing relative to GDP growth. The projections reflect anticipated substitution of electronic media for some communication grades of paper. U.S. per capita consumption of newsprint for example peaked in the 1980s and has actually declined in the past decade. Other grades of paper are increasing in per capita consumption and their demands have been complemented by development of electronic technology, for example uncoated free sheet paper used heavily in electronic printers and copiers. Despite decelerating per capita demands, the overall tonnage of U.S. paper and paperboard consumption is projected to increase along with projected population growth, as shown in figure 3.

U.S. production and trade

Since 1970, U.S. production of paper and paperboard increased by more than 40 million metric tons, while imports and exports each rose by about 5 million tons. Although recent UN-FAO projections predict a decline in U.S. paper and paperboard exports to the year 2010 (FAO 1996), U.S. exports and imports are both projected to increase in the 1998 NAPAP Model after a near-term downturn (stemming from the Asian economic crisis). Nevertheless, projected U.S. trade flows remain small relative to domestic production (figure 4). U.S. paper and paperboard imports are projected to increase until around the year 2020 when projected imports level off with slower growth in domestic paper consumption. Imports from Canada, primarily newsprint and printing & writing grades of paper, are projected to remain dominant, but imports from other world regions also increase and are projected to double in the decades ahead (figure 5). Canadian domestic pulpwood supply is projected to increase, but Canadian pulpwood harvest is projected to decline as Canadian wood residue supplies increase. Wood residue supplies are projected to increase in Canada due to projected increases in Canadian softwood lumber production.

U.S. production of both paper and paperboard are projected to increase (figure 6). Paper production is projected to gradually level out with maturing market demand, while paperboard production is projected to increase on a more linear trend. The gradual shift from paper to paperboard production implies a gradual shift toward higher yield pulping and increased use of recycled fiber.

The rate of recovery of paper for recycling (relative to total U.S. consumption) is projected to increase in the future, but growth in the rate of recovery will decelerate as the United States reaches a more balanced equilibrium between recycled fiber demand and supply (figure 7). Paper recovery for recycling and export increased significantly since the mid-1980s, but the 1998 NAPAP Model indicates that paper recovery for recycling is approaching an equilibrium at the upper end of an historical sigmoid growth trend. A sustained recovery rate above 50 percent is projected beyond the turn of the century when U.S. recovery of paper for recycling will be in the range of current high rates of recovery in Japan and Europe, but recovery will climb only very slowly above the 50 percent level.

The distribution of U.S. paper and paperboard production capacity is shifting to a higher proportion of capacity based on processes using 100% recycled fiber, but production capacity based mainly on virgin pulp is also projected to increase (figure 8). The domestic recovered paper utilization rate (ratio of recovered paper use to production of paper and paperboard in U.S. mills) increased significantly over the past decade. The utilization rate is projected to increase much more gradually in the decades ahead with slower growth in equilibrium recovery rates as computed by the NAPAP Model (figure 9). Projected increases in U.S. paper and paperboard production coupled with decelerating rates of paper recycling imply increased demand for virgin wood fiber.

Equilibrium fiber raw material consumption

Figure 10 shows historical and projected roundwood equivalents of wood and fiber raw materials consumed annually in the entire U.S. pulp and paper sector over a 150-year historical and projected time frame. Decelerating growth in equilibrium supply-demand quantities is apparent in the historical and projected trends, attributable to maturing market demands and limitations on fiber supply, but the upward momentum of demand results in robust projections of fiber consumption well into the next century.

Imports of fiber (pulpwood and woodpulp) are projected to increase but remain small relative to domestic sources of wood fiber. Use of recycled fiber has increased and is projected to increase at a somewhat slower pace in the future. Use of wood residues (chiefly byproducts of sawmills and plywood mills) peaked in the mid 1980s and is projected to continue declining as more efficient sawmills and plywood mills generate less wood residues and as expansion occurs in newer composite wood panel products that do not generate wood residues, such as oriented strandboard (OSB) which is replacing plywood. Pulpwood harvest is projected to increase in the future along with slower projected growth in rates of paper recycling and declining wood residue supplies.

Pulpwood market outlook

Historical and projected equilibrium pulpwood supply-demand quantities by region are shown in figure 11. The South has dominated U.S. pulpwood supply and demand in recent decades, and the South is projected to remain dominant in the future. The South Central region in particular has accounted for the largest share of growth in U.S. pulpwood supply and demand, and the South Central region is projected to account for most projected growth in the future (states in the South Central region include Alabama, Arkansas, Kentucky, Louisiana, Mississippi, Oklahoma, Tennessee, and Texas)."

Increased pulpwood demand in the U.S. South was associated with increased pulpwood stumpage values in recent years, particularly since the mid-1980s. Figure 12 shows historical and projected trends in real pulpwood stumpage prices in the U.S. South, comparing hardwood and softwood stumpage prices. Both hardwood and softwood stumpage prices have increased in the past decade, with the percentage increase much greater for hardwood than for softwood (in real prices, hardwood stumpage has approximately tripled in value since the early 1980s, and now exceeds the market value that softwood pulpwood had ten years ago). Hardwood and softwood equilibrium stumpage prices are both projected to more than double in the U.S. South in the next ten years, according to the 1998 NAPAP Model. This analysis is linked to the TAMM/ATLAS assessment of timber growth and timber supply, and results are sensitive to timber growth assumptions in the U.S. South. The Forest Service is in the process of revising and updating RPA timber growth assumptions for private timberlands in the U.S. South, and higher growth assumptions may result in somewhat smaller projected increases in pulpwood stumpage markets.

The projected increases in pulpwood prices indicate that it will become economically feasible in the near future to grow larger volumes of hardwood short-rotation woody crops (SRWC) on agricultural land. Beyond the year 2010, there is a significant projected increase in U.S. supply of hardwood pulpwood from agricultural lands (hardwood SRWC). Hardwood SRWC supply reaches an equilibrium of 20 percent of total pulpwood supply by the year 2050 in this analysis, substituting for harvest of hardwood pulpwood on forest lands. Figure 13 shows the historical and projected distribution of total U.S. pulpwood supply. Softwood and hardwood timber harvest provide the bulk of projected pulpwood supply, as wood residue supplies are projected to decline.

Hardwood short-rotation woody crop technology has been applied by a number of U.S. forest product companies, primarily growing hybrid poplars on leased agricultural land with harvest rotations of around 6 to 8 years.

¹²Pulpwood quantities discussed in this paper exclude wood use in OSB.

This analysis suggests that the total agricultural land area devoted to growing such short-rotation woody fiber crops could approach two million hectares by the year 2050 (an area perhaps 50 times greater than the current agricultural land area devoted to hardwood SRWC, but an area which is nevertheless less than two percent of the total land area of agricultural cropland in the United States). These results are sensitive however to alternative assumptions regarding future timber management intensity on forest lands. If the intensity of timber management and pulpwood production from forest lands increase in the U.S. South, there will be less likelihood for significant expansion of hardwood short-rotation woody crop supply from U.S. agricultural land.

Summary

As shown in figure 14, this analysis reveals that fiber raw material use per ton of pulp, paper and paperboard production has declined in the United States since the 1950s, and a continued gradual decline is projected into the future associated with a shifting mix of production technologies and product outputs (gradually shifting toward higher levels of recycling and from paper to paperboard for example). Of particular note is the decline in use of pulpwood per ton of product output, with total domestic pulpwood input (roundwood and residues) declining historically from around 3 cubic meters per metric ton in the late 1950s to just above 2 cubic meters today. Domestic pulpwood input (including timber harvest, residues, and SRWC supply) is projected to be less than 2 cubic meters per ton of product output by the year 2050. Pulpwood input obtained from domestic forest harvest (exclusive of residues and imports) reached 2.5 cubic meters per ton of product output by 1960, but declined historically to only 1.7 cubic meters by the late 1990s, and is projected to decline to 1.1 cubic meters by the year 2050 (excluding projected increases in agricultural SRWC supply). Thus, technological progress, evolution of markets, and fiber substitution in pulp and paper have accomplished great strides in conservation of forest resources in recent decades and are projected to accomplish further strides in the future. However, total consumption of wood and wood fiber raw materials in pulp and paper is nevertheless projected to increase in the future as shown in figure 10, with resulting increases in supply and consumption of pulpwood as shown in figures 11 and 13.

Consumption of wood and fiber raw materials in pulp, paper and paperboard production increased in the United States over the past century and is projected to increase in the future at a decelerating rate of growth (figure 10), based on detailed economic assessment of supply, demand and production technology in the pulp and paper sector. Harvest of pulpwood on forest land in the United States is the largest single source of wood fiber, followed by recycled fiber and wood residues. In the past decade, residues declined in supply while use of recycled fiber increased. Recycled fiber use is projected to increase more steadily in the future with slower growth in rates of recovery and utilization of recycled paper.

Based on supply-demand analysis, equilibrium pulpwood stumpage values are projected to increase in the United States, and particularly in the U.S. South. Projected increases in the market value of pulpwood would improve economic prospects for growing short-rotation woody crops on agricultural land, and fiber supply from short-rotation woody crops is projected to increase. Harvest of pulpwood on forest land is nevertheless projected to provide the bulk of total U.S. pulpwood and wood fiber supply through the first half of the next century (60 to 70 percent of total pulpwood supply) as supplies of wood residues are projected to decline. Softwood pulpwood harvest on forest land in particular is projected to increase as supplies of softwood residues decline.

Most future growth in pulpwood equilibrium supply-demand quantities is projected to occur in the U.S. South, and particularly the South Central region. The South is projected to remain the dominant region in pulpwood supply and in production of pulp, paper and paperboard products. Pulpwood supply-demand quantities are projected to remain relatively static in the U.S. North and U.S. West.

Figures

Figure 1.--US. population and annual Gross Domestic Product (GDP) per capita.

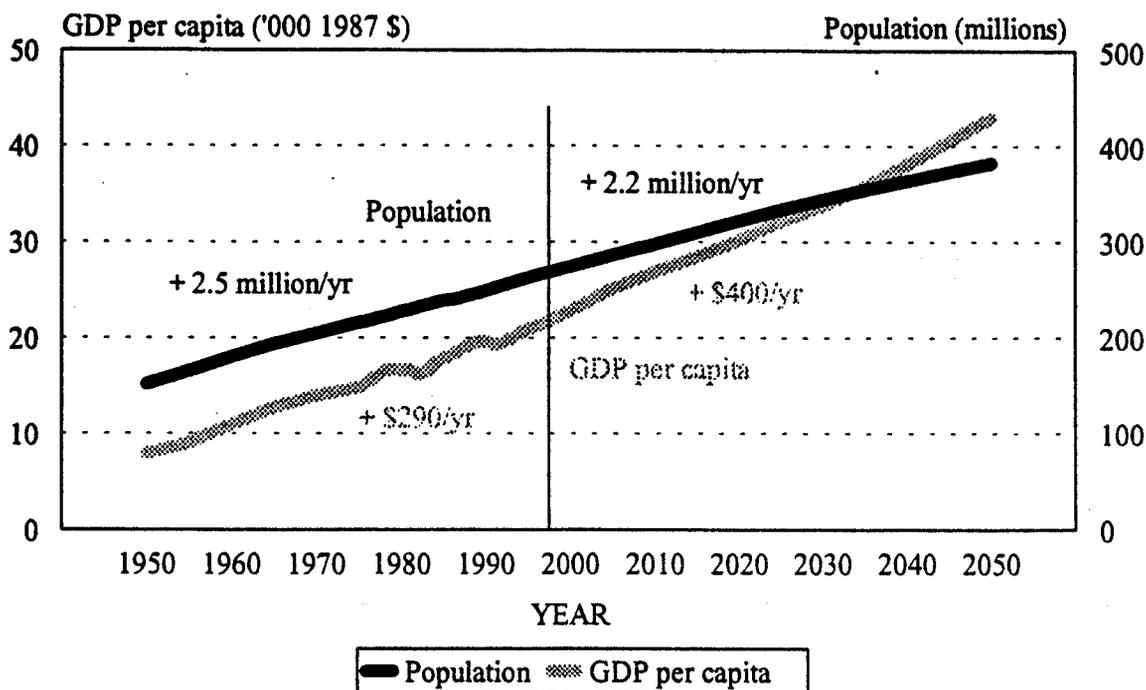
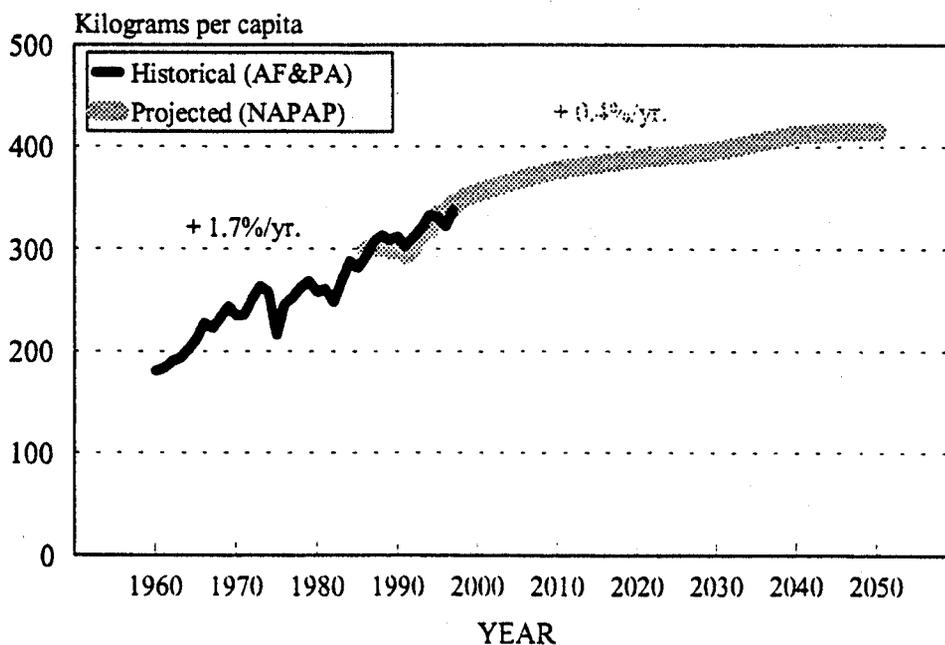
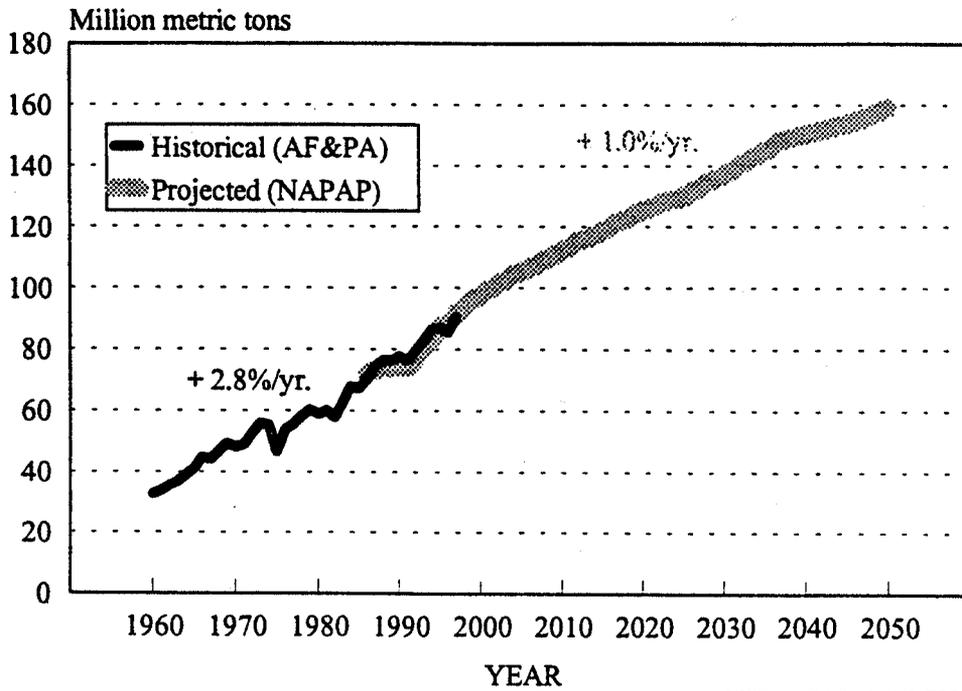


Figure 2.--U.S. annual per capita paper and paperboard consumption.



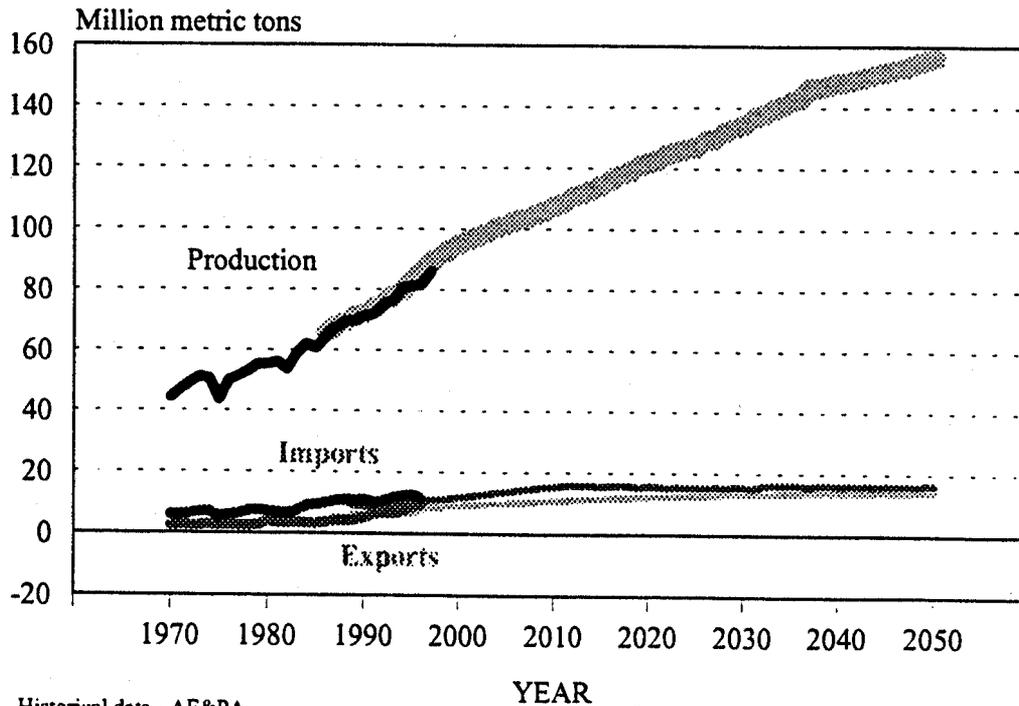
1998 NAPAP Model, FPL; 6/11/98

Figure 3.--Annual U.S. paper and paperboard consumption.



1998 NAPAP Model. FPL: 6/11/98

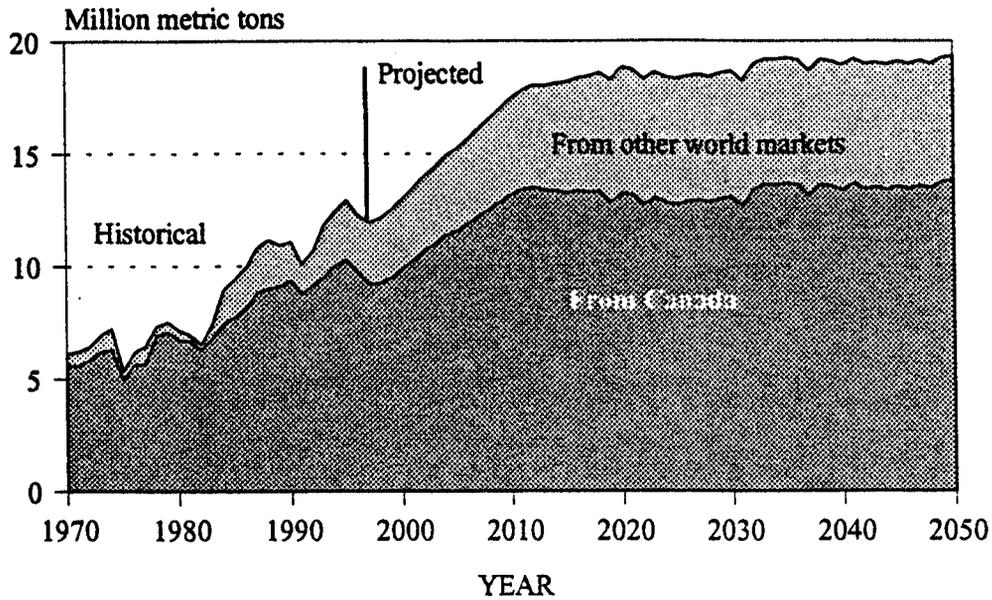
Figure 4.--U.S. paper and paperboard annual production and trade, historical and projected, 1970 - 2050.



Historical data - AF&PA

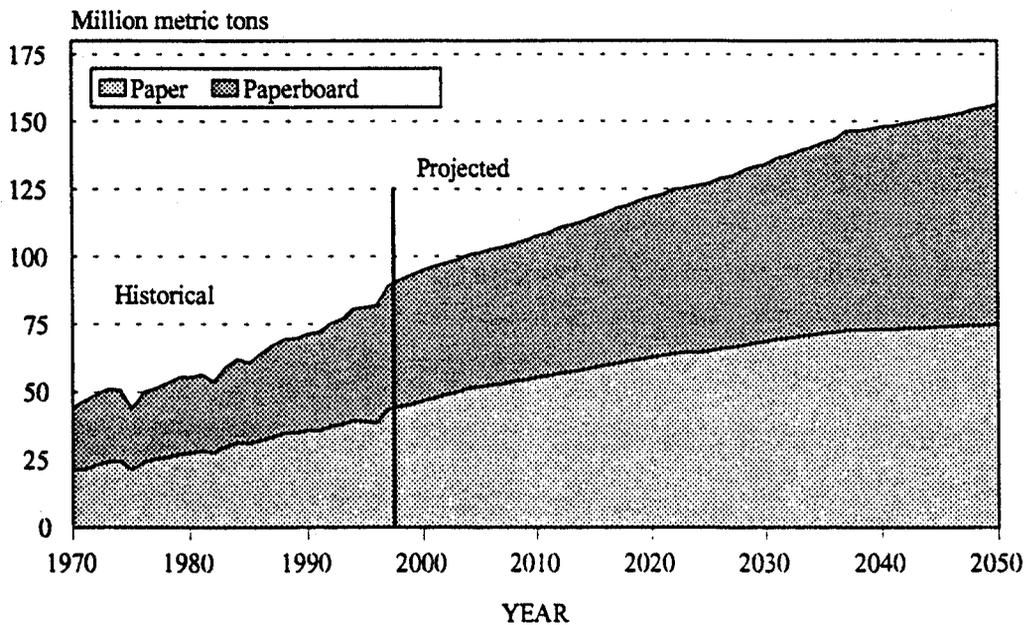
Projections - 1998 NAPAP Model. FPL: 6/11/98

Figure 5.--U.S.annual imports of paper and paperboard, historical and projected, 1970 - 2050.



1998 NAPAP Model, FPL; 6/11/98

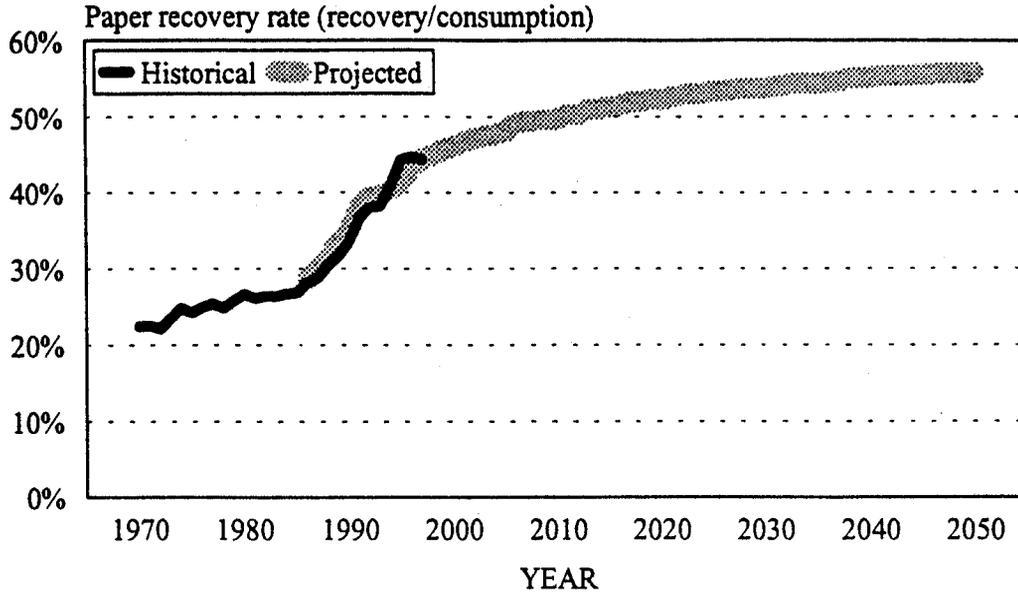
Figure 6.--U.S. annual production of paper and paperboard, historical and projected, 1970 - 2050.



Historical data - AF&PA

Projections - 1998 NAPAP Model, FPL; 6/11/98

Figure 7.--U.S. rate of paper recovery for recycling, historical and projected, 1970 - 2050.

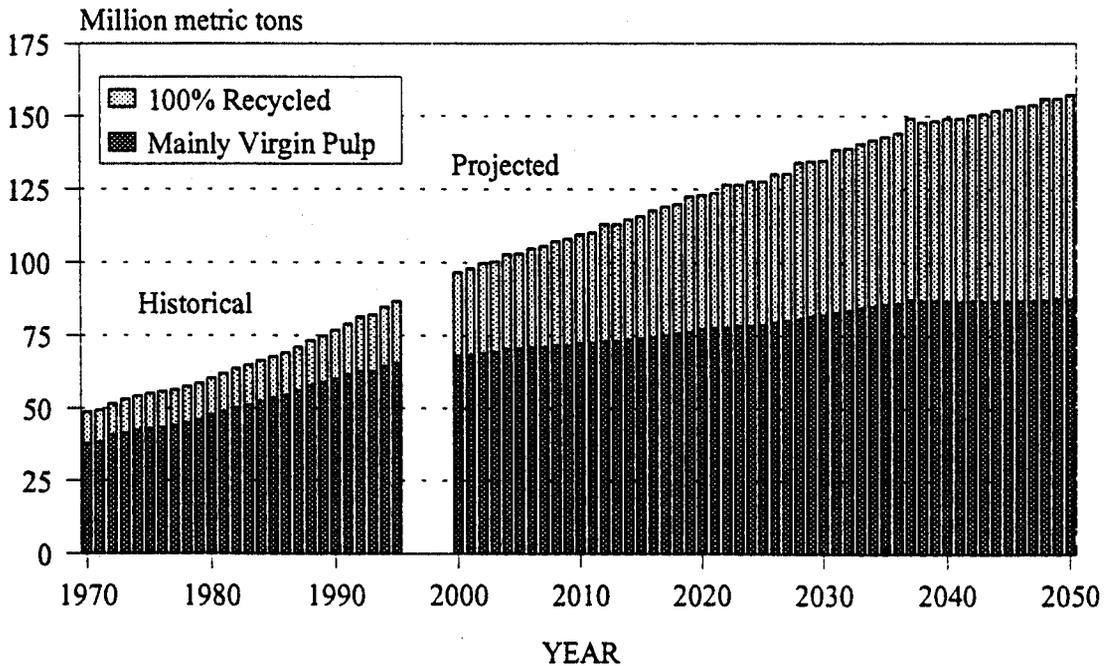


Recovery Rate = Tons recovered / Tons of paper and paperboard consumed

[Historical data include recovery for uses other than paper recycling, ~1% (AF&PA); Projections exclude other uses]

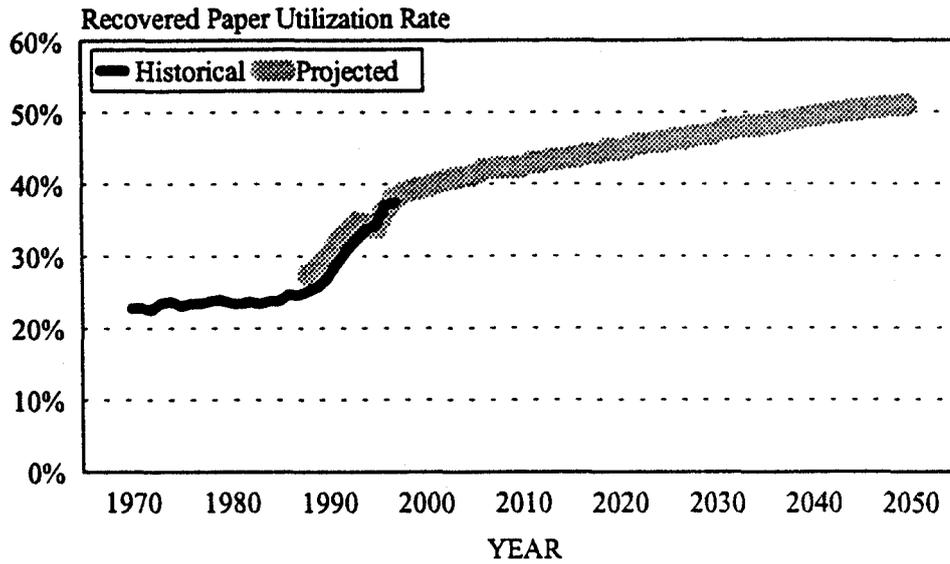
1998 NAPAP Model FPI - 6/11/98

Figure 8.--Total U.S. paper and paperboard annual production capacity by type of process, historical and projected, 1970 - 2050.



1998 NAPAP Model, FPL: 6/11/98

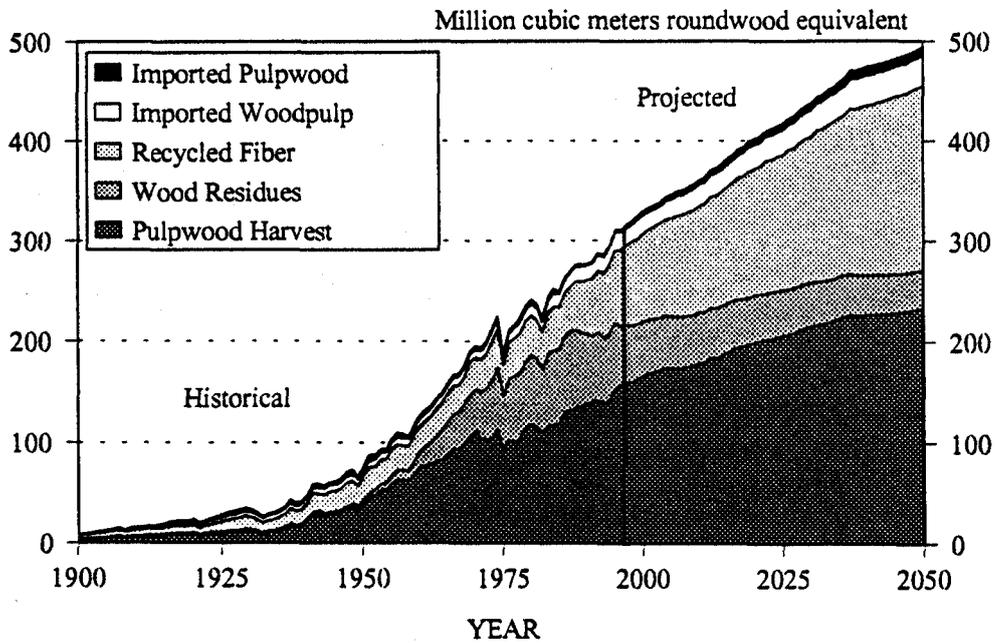
Figure 9.--U.S. recovered paper utilization rate, historical and projected, 1970 - 2050.



Utilization Rate = Tons utilized at mills / Tons of paper and paperboard produced

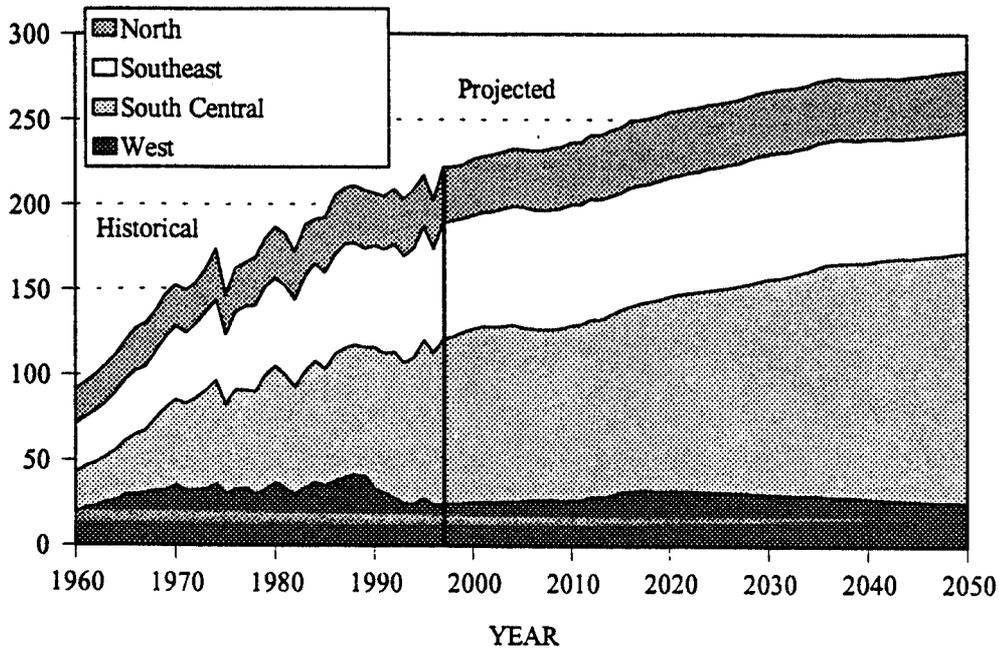
1998 NAPAP Model, FPL; 6/11/98

Figure 10.--Annual consumption of wood and fiber raw materials in pulp, paper and paperboard production in the United States, 1900 - 2050.



1998 NAPAP Model, P. Ince, FPL; 6/11/98

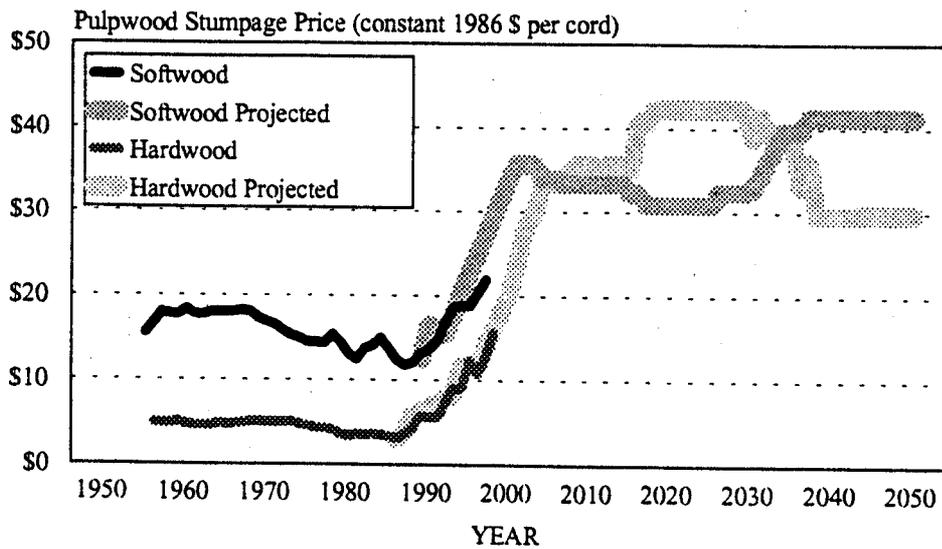
Figure 11.--Annual pulpwood equilibrium supply and demand quantities by region in the United States, historical and projected, 1960 - 2050.



Pulpwood supply includes timber harvest, residues and SRWC supply

1998 NAPAP Model, P. Ince, FPL; 6/11/98

Figure 12.--Historical and projected pulpwood stumpage market trends in U.S. South, hardwood and softwood, 1950 - 2050.



Historical data: US Forest Service and Timber Mart-South (Southwide Avg.)

1998 NAPAP Model, FPL; 6/11/98

Figure 13.--Annual pulpwood equilibrium supply quantities by species group and category in the United States, historical and projected, 1960 - 2050

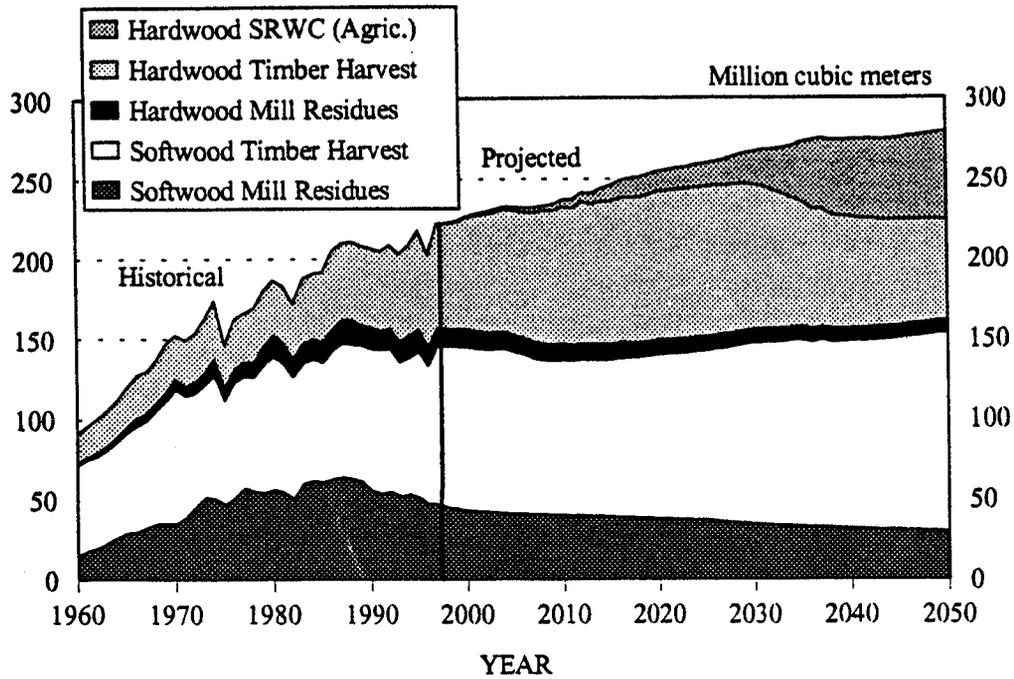
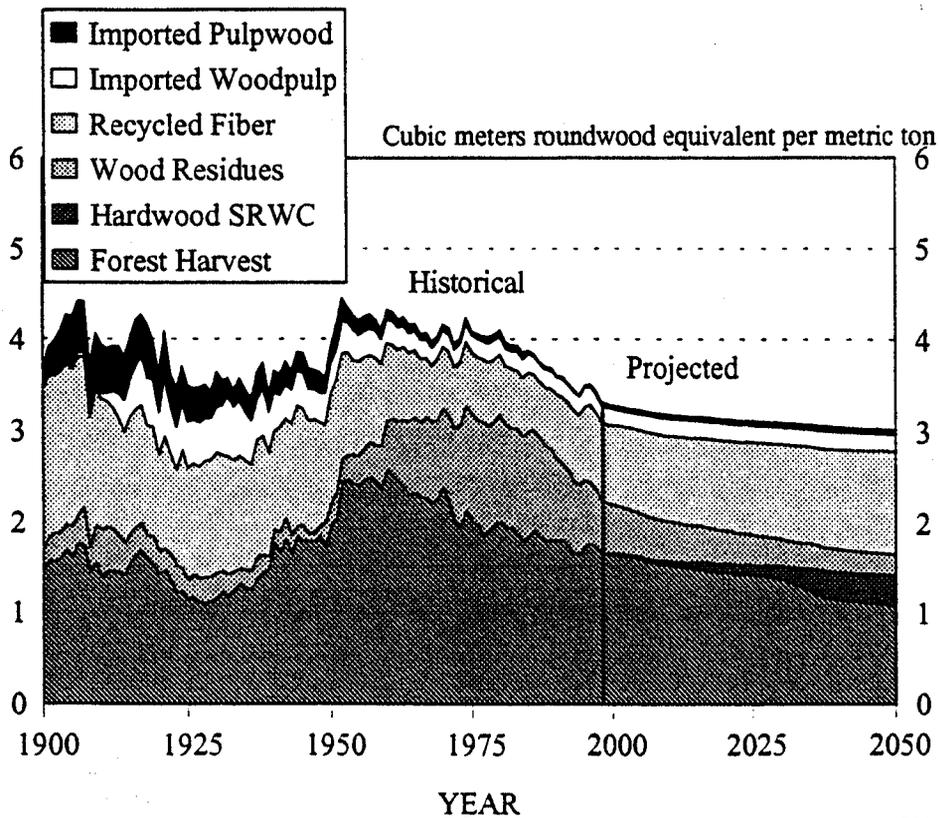


Figure 14.--Average fiber raw material use per ton of pulp, paper and paperboard produced in the United States, historical and projected, 1900 - 2050.



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Geneva, Switzerland

GENEVA TIMBER AND FOREST DISCUSSION PAPERS

RECYCLING, ENERGY AND MARKET INTERACTIONS

by
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Abstract

Recycling, Energy and Market Interactions contains the reports presented for the special topic at the UN-ECE Timber Committee’s 56th Session on 28 September 1998. The papers cover developments in wood and paper recycling and use wood in many forms for energy production. Together with a discussion of the influence of local, national and regional legislation, the resulting effects on forest management, forest products trade and forest products manufacturing are examined. A report on the following panel discussion gives a summary of the Committee’s questions and responses by the experts.

Keywords

Forest products, wood products, paper, wood fibre, recycling, wood-based energy, wood fuel, renewable energy, forest products markets, recycling legislation, wood-based energy legislation, energy policy, forest plantation, wood residue.

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