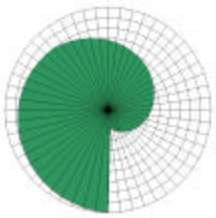


The Alberta GPI Accounts: Household and Public Infrastructure

Report # 5

by

Amy Taylor
Mark Anielski

October 2001

Pembina Institute
for Appropriate Development

About the Pembina Institute

The Pembina Institute is an independent, citizen-based organization involved in environmental education, research, public policy development and corporate environmental management services. Its mandate is to research, develop, and promote policies and programs that lead to environmental protection, resource conservation, and environmentally sound and sustainable resource management. Incorporated in 1985, the Institute's main office is in Drayton Valley, Alberta with additional offices in Calgary and Ottawa, and research associates in Edmonton, Toronto, Saskatoon, Vancouver and other locations across Canada. The Institute's mission is to implement holistic and practical solutions for a sustainable world.

The Green Economics Program is dedicated to designing and implementing practical, street-smart economic tools that would reorient society back to the original meaning of the word "economy"—the care and management of the wealth of the household. By developing new tools for measuring the true wealth or well-being of nations, we can help guide Canadians and Albertans to a sustainable future.

For more information on the Pembina Institute's work, please visit our website at **www.pembina.org**, or contact:

The Pembina Institute
Box 7558
Drayton Valley, AB T7A 1S7
tel: 780-542-6272 fax: 780-542-6464
e-mail: info@pembina.org

About this Report

This is one of 28 reports that provide the background for the Genuine Progress Indicators (GPI) System of Sustainable Well-being Accounts. It explains how we derived the indices that were earlier published in *"Sustainability Trends 2000: The Genuine Progress Statement for Alberta, 1961 to 1999."* The research for this report was completed near the end of 2000. The appendices provide further background and explanation of our methodology; additional details can be obtained by contacting the authors. Appendix A includes a list of all GPI background reports.

In this report we explore the value of services from household and public infrastructure. Specifically we answer the following questions:

1) What is the value of services from household infrastructure in Alberta?
2) What is the value of the services from public infrastructure in Alberta?
3) How have the values of the services from household and public infrastructure changed from 1961 to 1999?
4) Is the growth in the net capital stock of the province sufficient to support the growing provincial labour force?

 ISBN 0-921719-52-3

About the Authors

Amy Taylor is a senior researcher with the Pembina Institute's Green Economics program. She works on establishing measurements of ecological well-being and community sustainability reflected in genuine progress indicators using time series analysis and valuation methods. Amy came to the Institute following contract work with the B.C. Ministry of Finance, where she was the lead author and researcher for the B.C. Government's 1999 discussion paper, "Environmental Tax Shift: A Discussion Paper for British Columbians." She has been a researcher, writer, and public speaker in this field for four years, and combines a background in economics, energy research, and environmental science. Her 1999 Masters in Resource Environmental Management focused on ecological tax reform. Her education includes MRM degree (Masters of Resource Environmental Management) from Simon Fraser University and B.Sc. Hon. (Economics and Environmental Science) from Trent University.

Mark Anielski is Director of the Green Economics team, and has considerable experience in public policy analysis including natural resource, energy, royalty and fiscal policy issues in both the public (Alberta Government) and private (GPC – Government Policy Consultants) sector. He also serves as Senior Fellow to the U.S. economic policy think-tank Redefining Progress in Oakland, California and authored the 1999 U.S. GPI report with journalist Jonathan Rowe. He currently advises the National Round Table on Economy and the Environment's Sustainable Development Indicator Steering Committee on the development of indicators for measuring sustainability in Canada. Mark teaches business and the environment in the University of Alberta's School of Business. His expertise is varied and broad including accounting for sustainable development, natural resource accounting, public policy analysis, business planning and performance measurement. Mark pioneered the development of natural capital accounts for Alberta's timber, oil, gas, coal and other natural capital as well as having experience in the development of performance measurement systems, land use planning and non-market resource valuation, royalty policy analysis (forestry, oil and gas), and analysis of subsidies for both government and private forestry, energy and financial service industries. He holds a Masters degree in forest economics, plus bachelor degrees in economics and forestry.

Acknowledgements and Disclaimer

The authors thank a number of individuals for their contributions to this document. Some provided data while others gave their time to review draft material, discuss the issues and offer valuable comments that helped improve the content. We particularly acknowledge Flo Magmanlac, Statistics Canada; Clive Hamilton, Australia Institute; and Merv Henning and Roy Jurgens, Alberta Infrastructure.

The high quality of the data compiled by Statistics Canada and the opportunity to use this data enabled us to undertake a much more thorough analysis than would otherwise have been possible. We also thank Kim Sanderson for her editing assistance. Finally, the Pembina Institute appreciates the vision of Western Economic Diversification in supporting this project—the first of its kind for Alberta, if not internationally.

The contents of this report are the responsibility of the Pembina Institute and do not necessarily reflect the views and opinions of those who are acknowledged above or the opinions or positions of Western Economic Diversification who helped fund the research.

We have made every effort to ensure the accuracy of the information contained in this document at the time of writing. However, the authors advise that they cannot guarantee that the information provided is complete or accurate and that any person relying on this publication does so at their own risk. Given the broad scope of the project and time constraints, it has not been possible to submit the entire report for peer review. The material should thus be viewed as preliminary and we welcome suggestions for improvements that can be incorporated in any later edition of the work.

Contents

Figures

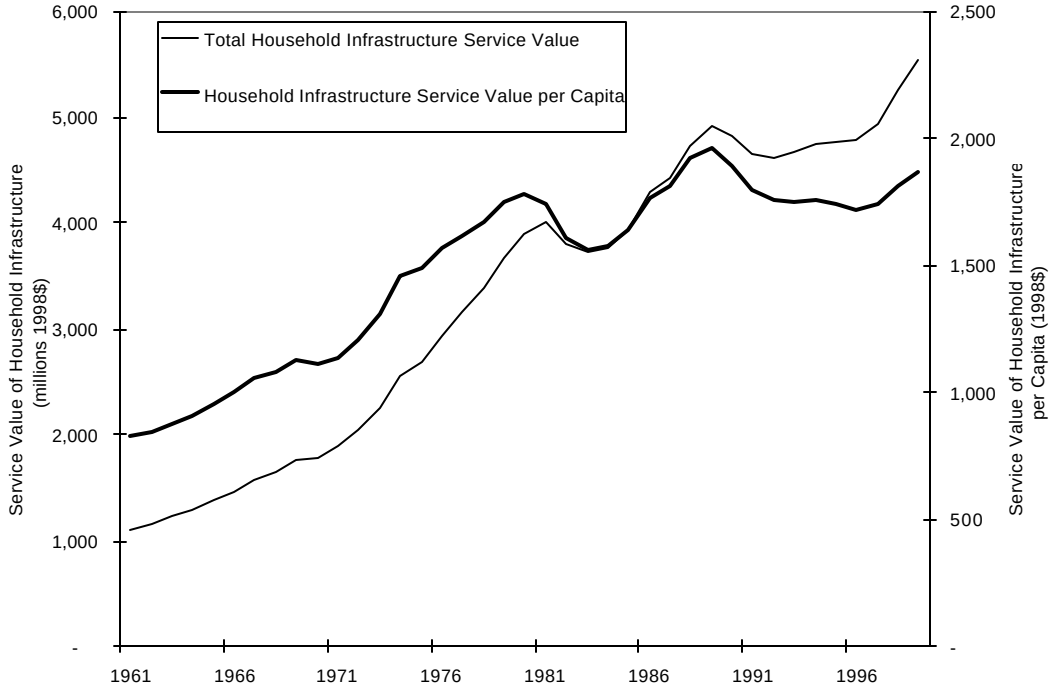
1 Executive Summary

This report investigates three main items:

- the value of services from household infrastructure;
- the value of services from public infrastructure; and
- the growth of net capital stock corrected for changes in the labour force.

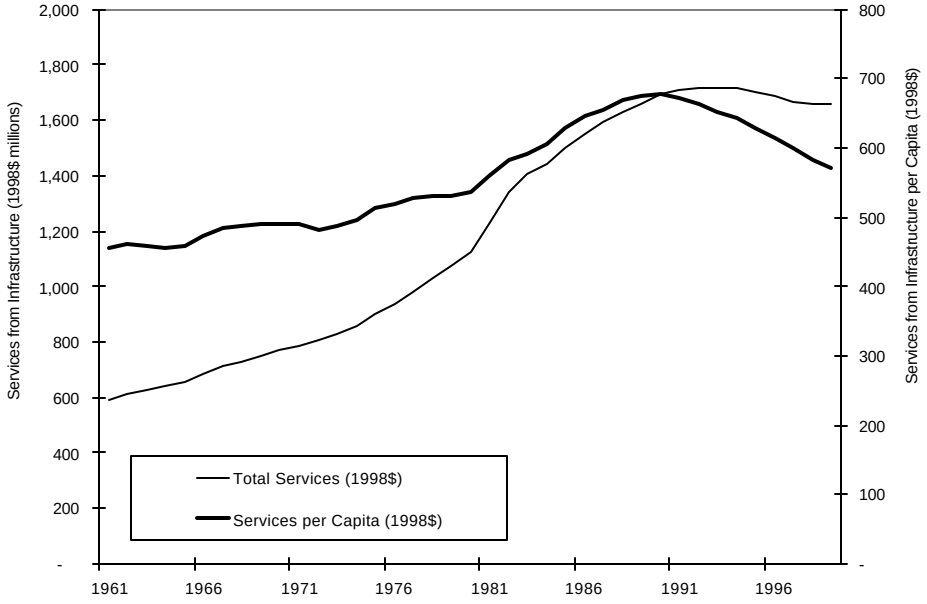
The value of services from households grew from 1961 to 1999 (see figure below), the result of increased investments by Albertans in household infrastructure—such as dishwashers, stoves and refrigerators—and the steady rise in cost of household infrastructure over the study period.

The Value of Services from Household Infrastructure in Alberta, 1961 to 1999



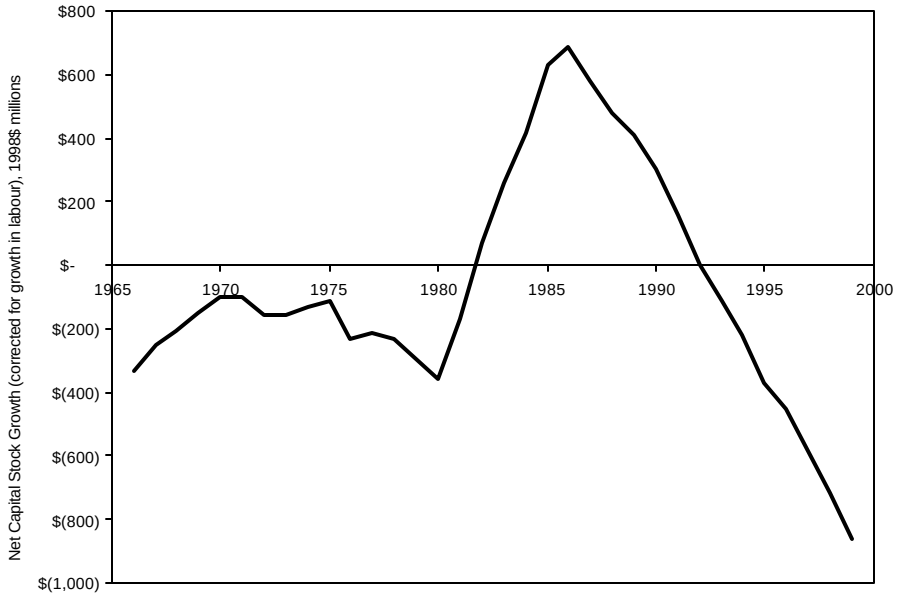
The value of services from public infrastructure rose, and then declined in the 1990s, as shown in the figure below. This decline was due to limited new investment in public infrastructure in Alberta.

The Value of Services from Public Infrastructure in Alberta, 1961 to 1999



This report also investigates the growth in net capital stock in Alberta from 1961 to 1999, taking into account changes in the provincial labour force over the same time period, to discern whether the growth in capital is adequate to support a growing provincial labour force. Although Alberta experienced positive net capital stock growth through most of the 1980s, even when adjusted for increases in the provincial labour force, this is no longer the case. Since 1991, the growth in net capital stock in Alberta has not been sufficient to support the growing labour force. From a sustainability point of view, the gap between the growth in net capital stock and growth in the labour force indicates that one or the other will have to adjust. The figure below shows the results of this analysis.

Net Capital Stock Growth Corrected for Changes in the Labour Force in Alberta



2 Household Infrastructure

2.1 Why Measure the Value of Services from Household Infrastructure?

The Gross Domestic Product records economic transactions in the marketplace. For example, when a family invests in a new car, dishwasher or refrigerator, the GDP records these transactions and goes up. The GDP as a measure of well-being therefore, tells us that the more money we spend on household appliances and personal automobiles, for instance, the better off we are. In other words, the sooner the car or dishwasher breaks down and has to be replaced, the more our well-being increases. However, households actually get more value from the infrastructure if it lasts longer. Thus, by focusing on the cost of the purchase, the GDP does not accurately reflect the quality, service life, and value of the services received from the purchase. The GDP is indifferent to changes in the quality of household appliances and the quality of housing, for example. Indeed, inferior consumer durables (e.g., refrigerators, stoves, furnaces) and building products for home construction would add more to GDP over time than higher quality, yet more expensive durables and materials because more of the inferior items would be used up. When we buy such items we do not "consume" them in one year; yet this is how GDP accounts for such purchases.

In reality, a car or dishwasher services the household for many years. Any measure of well-being should account not for the cost of the infrastructure but rather for the services received from the infrastructure. It is not the value of a dishwasher that increases well-being *per se* but the value of the service of cleaning dirty dishes. Some progressive companies like Interface Inc., one of the world's largest carpet manufacturers, and IKEA are beginning to see themselves not as manufacturers of items for final consumption (e.g., a carpet that consumers buy, own, and eventually landfill), but rather as providers of "service" from the products they manufacture. Interface has re-engineered its industrial complex and carpets such that it offers "service lease" agreements where consumers lease the carpet and benefit from its service value while the company retains ownership of the product, from "cradle to grave."[a] Industry observers are closely watching Interface's actions. This approach contributes to the well-being of consumers by providing them what they need (service from carpets) while reducing the throughput of materials and using materials more efficiently. Reducing disposal of carpet materials and reducing toxic inputs will ultimately reduce consumption and the ecological footprint of society, but may also dampen GDP, at least in terms of sales of disposable products. On the other hand, service agreements and associated transactions plus the extra labour and energy required to recycle and reuse unwanted carpets will help to increase expenditures and GDP.

The GPI accounts would celebrate the shift that Interface and others are making to what is known as "industrial ecology" where waste is reduced and products are turned into services. These activities contribute to the genuine progress of society and the environment as a whole. Future GPI accounts should be sensitized to these efforts of the pioneers of industrial ecology and to movements such as "The Natural Step" for business (www.naturalstep.org), counting them as positive contributions to well-being while identifying traditional materially- and energy-inefficient production as regrettable and detracting from long-term sustainability and well-being.

The GPI attempts to account for the value of services from household infrastructure by measuring the flow of services from the stock of household infrastructure rather than the expenditures on the infrastructure itself. Focusing on the annual service that equipment provides rather than on the

[a] "Cradle to grave" refers to the management of goods and materials through the entire life cycle, from manufacturing at the plant to eventual disposal, re-use or recycling.

purchase price, corrects the GDP approach of treating money spent as if it were the same as value received. In doing so, the GPI recognizes that, dollar for dollar, products that wear out quickly provide less value than those that last longer.

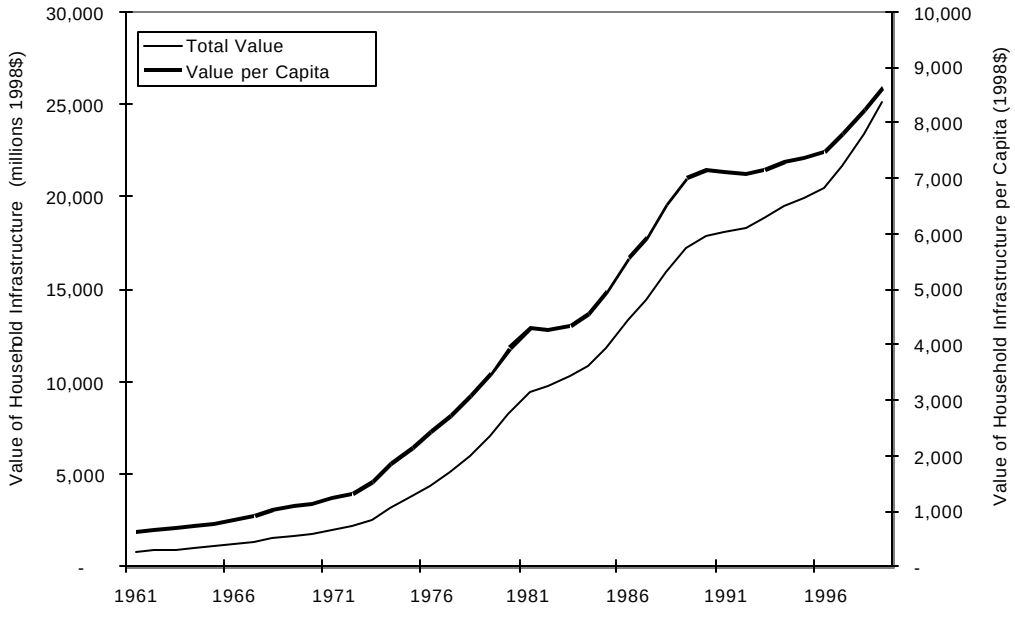
2.2 How are the Services from Household Infrastructure Measured?

The GPI measures the services of household infrastructure as benefits and the initial purchase prices of the infrastructure as costs. In keeping with economic theory, the value of the services is defined as the sum of the depreciation rate and the interest rate. The depreciation rate is assumed to be 15 percent of the total asset value of the stock of household infrastructure while the interest rate is assumed to be 7.5 percent of the asset value of the stock of household infrastructure. Thus, the value of services from household infrastructure is equal to 22.5 percent (7.5 percent plus 15 percent) of the value of the stock. Expenditure on household infrastructure is subtracted from the GPI to avoid double counting. In this analysis, household infrastructure includes all consumer durables.

2.3 Household Infrastructure: How Much?

Figure 1 shows both the total asset value and the asset value per capita of household infrastructure in Alberta from 1961 to 1999 (1998$). As the figure indicates, the asset value has increased substantially over the study period. Total assets increased from $811-million (1998$) in 1961 to $25,071-million (1998$) in 1999. Likewise, asset value per capita increased from $625 (1998$) to $8,625 (1998$) over the same period.

Figure 1: Asset Value of Household Infrastructure in Alberta, 1961 to 1999 (1998$)

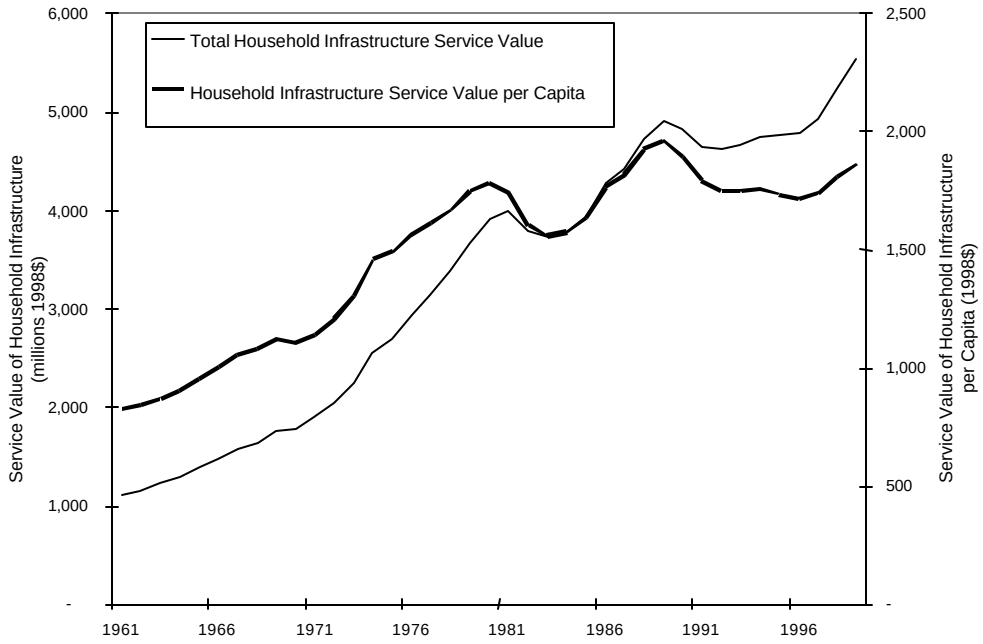


Source: Statistics Canada, National Balance Sheets, Table 378-0004

2.4 The Benefits of Household Infrastructure

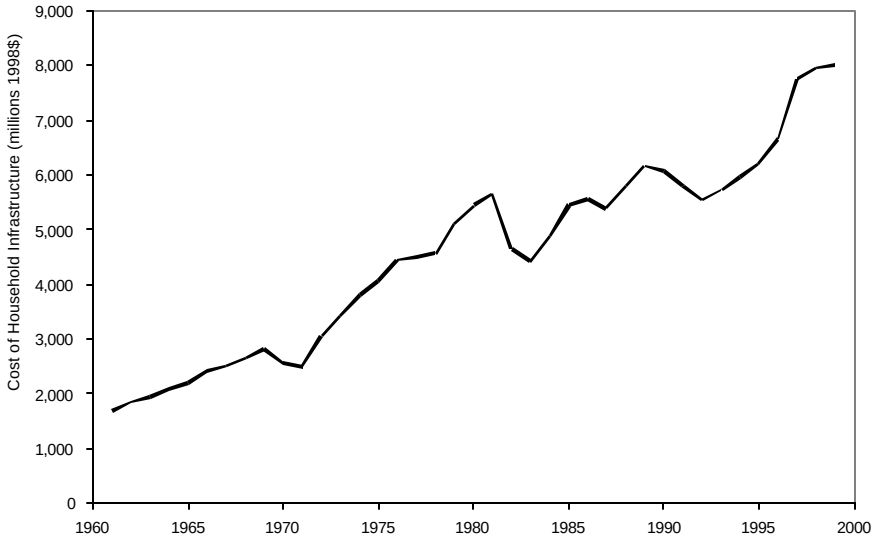
Figure 2 shows the value of the services received from household infrastructure in Alberta from 1961 to 1999. The value of services from household infrastructure increased gradually over the study period, from a total of $1,105-million (1998$) in 1961 to $5,532-million (1998$) in 1999. The service value of household infrastructure will increase if consumers invest in additional infrastructure (thus increasing the asset value of household infrastructure) or if the life of the infrastructure increases. This latter effect leads to a decline in the cost of household infrastructure,[b] which thus increases the total value of the services from the infrastructure. In other words, the increase depicted in Figure 2 below could be the result of more Albertans acquiring infrastructure and thus benefiting from the services the infrastructure provides, or it could be because the life of the province's infrastructure is increasing. Figure 3 shows the substantial increase in the cost of household infrastructure in Alberta from 1961 to 1999, which indicates that indeed more money is being spent on infrastructure. Thus the increase in the service value of household infrastructure is more likely due to more Albertans purchasing household infrastructure than to an increase in the life of the infrastructure itself.

Figure 2: The Value of Services from Household Infrastructure in Alberta, 1961 to 1999



[b] Longer life means fewer investments in infrastructure so there is less expenditure, which leads to a decline in the cost.

Figure 3: Cost of Household Infrastructure in Alberta, 1961 to 1999

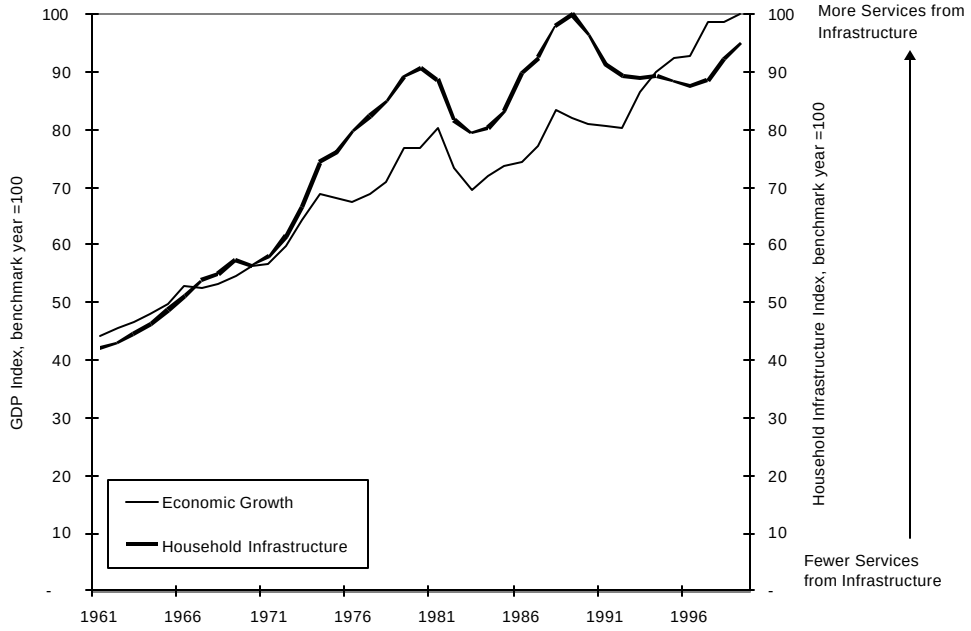


Source: Statistics Canada, National Balance Sheets, Table 378-0004

2.5 The Value of Services from Household Infrastructure as an Index

Figure 4 shows the service value of household infrastructure and GDP as indices. For the index, the year with the highest per capita value of services from household infrastructure is set equal to 100, and deviations from that benchmark year are measured as movement toward zero. The per capita value of services peaked in Alberta in 1989. The value of services from household infrastructure follows a similar pattern to the GDP. Thus, in times of economic growth in the province, the value of services from household infrastructure increased and in times of economic downturn, the value of such services declined.

Figure 4: The Value of Services from Household Infrastructure as an Index



3 Public Infrastructure

3.1 Why Measure the Value of Services from Public Infrastructure?

The GPI does not include most government expenditures because they are considered largely defensive in nature. In other words, rather than directly increasing the well-being of a region, such expenditures protect against the erosion of the quality of life. When the government spends money to fill potholes on a highway, for example, that expenditure does not increase society's well-being directly but just prevents it from eroding due to the presence of potholes. However, as was the case with household infrastructure, the GPI measures the value of services provided by public infrastructure. It is not expenditures on streets, highways and bridges themselves that increase the well-being of a region. Rather, it is the services that the infrastructure provides that are of value: the ability to move from place to place for work, social and other reasons. Thus, in GPI accounting, it is the value of services to households and businesses from public infrastructure, such as streets, highways and bridges that is measured.

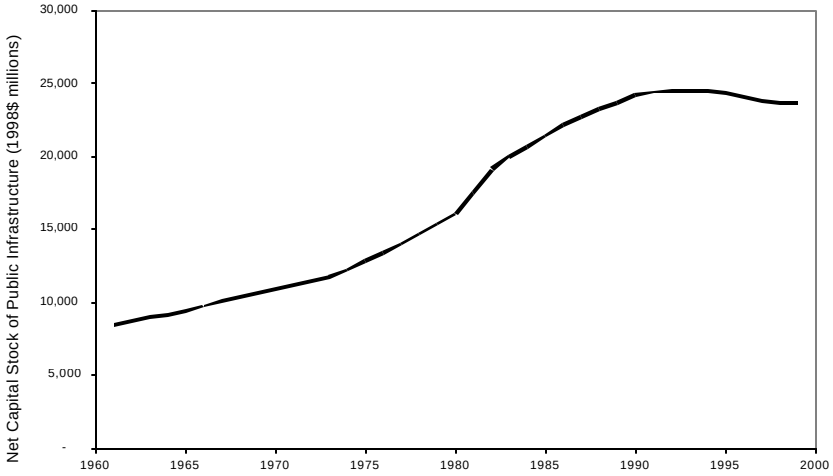
3.2 How are the Services from Public Infrastructure Measured?

As with consumer durables, the value of the services from public infrastructure is equal to the sum of the depreciation and the interest of the capital stock value of the infrastructure, in keeping with the Australia Institute's method of calculating the services from public infrastructure.[1] This value reflects two percent depreciation and a real interest rate of five percent, which is a reasonable proxy for the cost of capital for government. The five percent real interest rate demonstrates what the value of the infrastructure would be worth if it were invested for profit (the opportunity cost of the value of the infrastructure). In this analysis, we include publicly owned machinery and equipment, engineering structures and buildings as public infrastructure.

3.3 Public Infrastructure: How Much?

Figure 5 shows the value of the stock of public infrastructure in Alberta. The capital stock value of public infrastructure increased steadily from 1960 through the 1980s but remained relatively stable over much of the 1990s, declining slightly in recent years.

Figure 5: The Net Capital Stock Value of Public Infrastructure in Alberta, 1961 to 1999

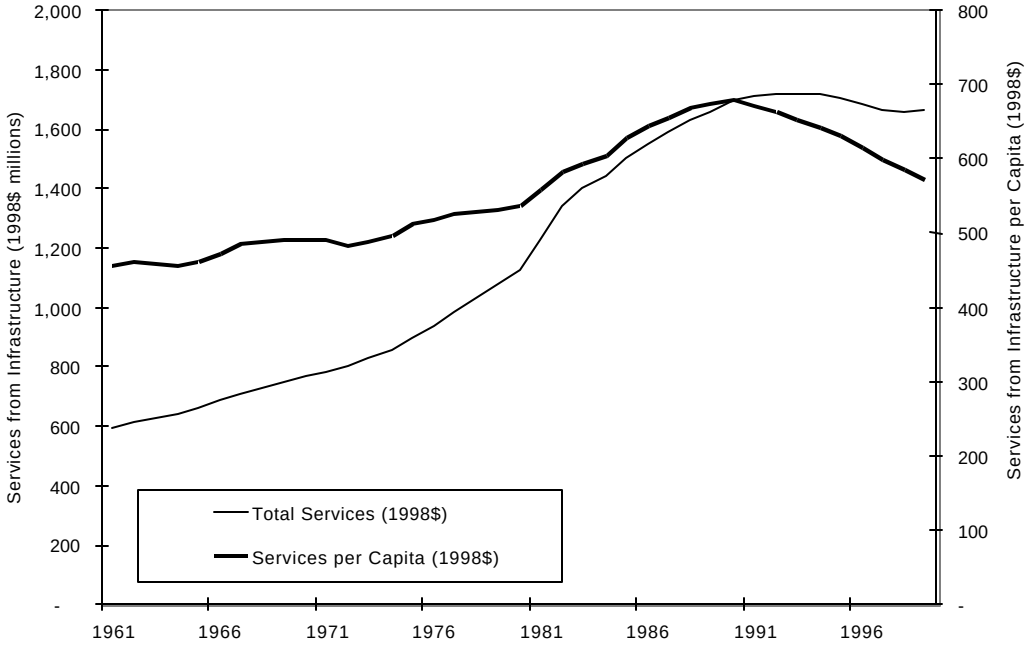


Source: Data from Statistics Canada, personal communication

3.4 The Benefits of Public Infrastructure

Figure 6 shows the value of services from public infrastructure in Alberta. Here we show both the total service value and the per capita service value from the province's public infrastructure. It is not surprising, given the leveling of the capital stock value of public infrastructure in the 1990s that the service value associated with that stock has declined over the same period. On a per capita basis, the value of services has declined every year since the peak in 1990.

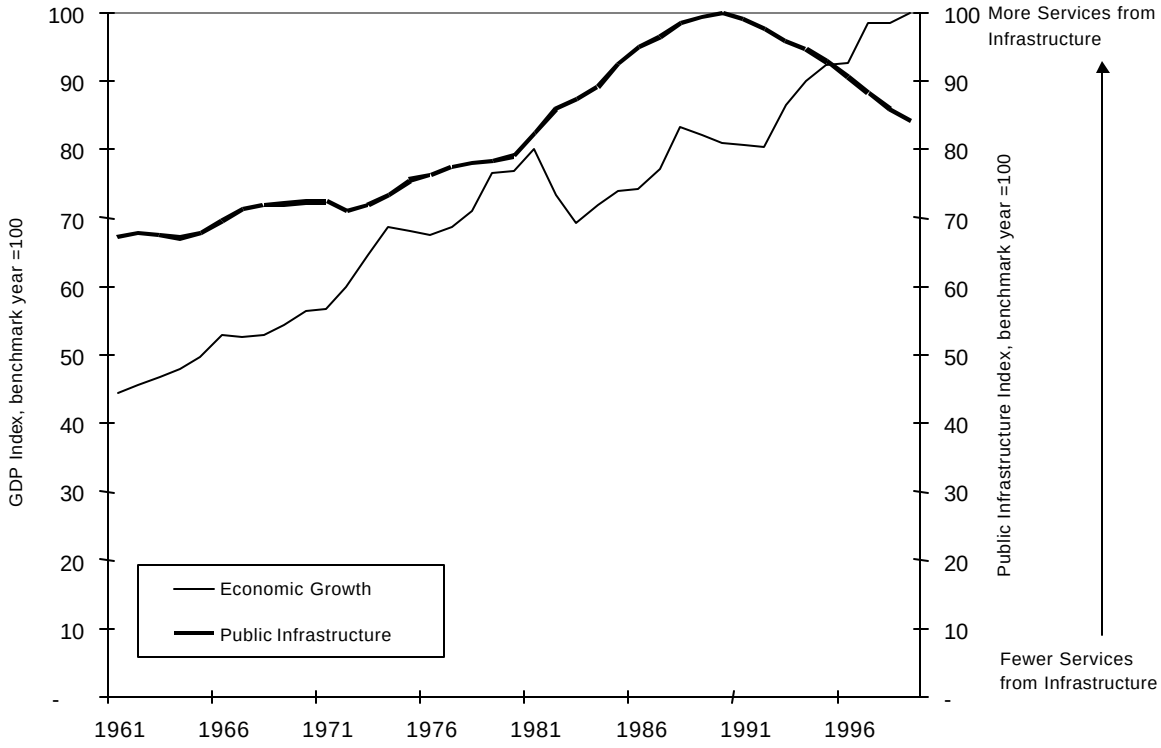
Figure 6: The Value of Services from Public Infrastructure in Alberta, 1961 to 1999



3.5 The Value of Services from Public Infrastructure, as an Index

Figure 7 shows the service value of public infrastructure and GDP as indices. For the index, the year with the highest per capita value of services from public infrastructure is set equal to 100, and deviations from that benchmark year are measured as movement toward zero. The per capita value of services peaked in Alberta in 1990. Despite continued growth in the provincial Gross Domestic Product, the index of the value of services from public infrastructure has been declining since the peak in 1990. Because the index is based on per capita services derived from public infrastructure, the decline in the index indicates that Albertans are experiencing declining service values even while GDP continues to expand.

Figure 7: GDP and the Value of Services from Public Infrastructure as Indices



In addition to considering the value of services from public infrastructure, the GPI includes an analysis of the growth in capital stock relative to the growth of the labour force in the province, as described earlier.

4 Net Capital Growth

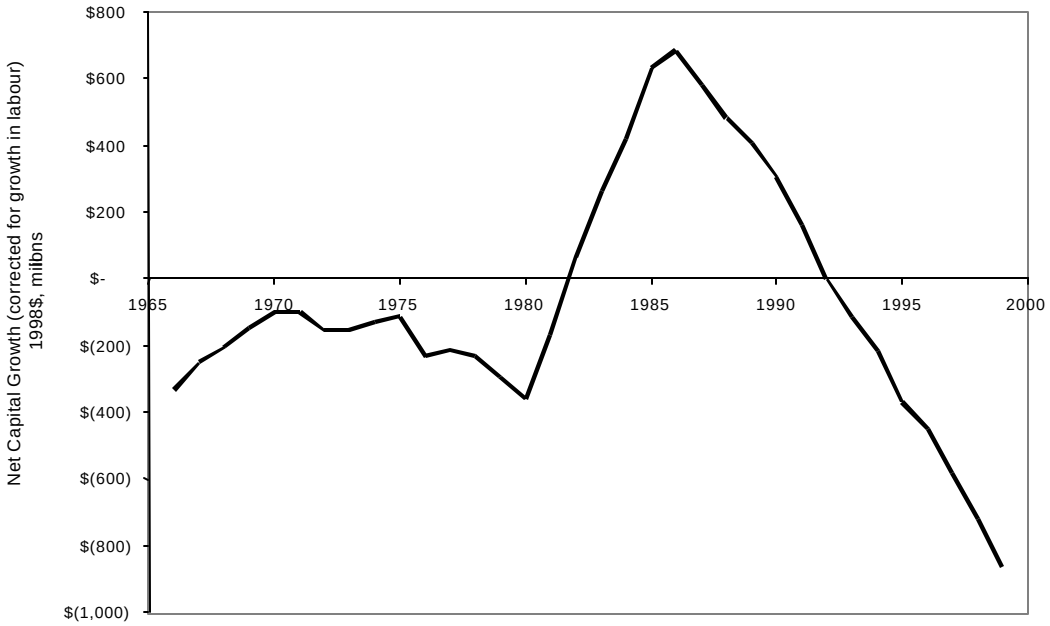
4.1 Why Measure the Net Capital Growth in Alberta?

The value of the capital stock of a region must be maintained to ensure adequate support for the current year's production but also to ensure the ability of future generations to produce goods and services. To achieve sustainability, the capital stock of a region, measured in this analysis as the public infrastructure, must be enough to support the labour force. Thus, if the labour force in a region increases, so too must the public infrastructure needed to support it. In this section we explore the growth in the capital stock (public infrastructure) in Alberta relative to the growth of the labour force to discern whether the change in capital stock is adequate.

4.2 How is Net Capital Growth Measured?

To see if the growth in provincial capital stock is sufficient to support a growing labour force, we first measure changes in annual capital stocks, net of depreciation. We use a five-year rolling average for the change in net capital stock to smooth for short-term fluctuations in the provincial economy. We then determine capital requirements for labour based on the relationship between capital stock and labour force from previous years. Next, we adjust the change in capital stock to account for growth in the provincial labour force. We use a five-year rolling average for the change in labour force as well to smooth out short-term fluctuations, thus results can only be shown from 1966 to 1999. The capital stock data used in this analysis came directly from Statistics Canada as a special data request, and the labour force data are also from Statistics Canada.[2] Figure 8 shows the net capital growth of capital corrected for increases in the provincial labour force. Where the line is greater than zero, the growth of net capital stock is more than sufficient to meet the growth of the labour force; i.e., even when labour force growth is taken into account, the province is experiencing an increase in the net capital stock in the province. Where the line is below zero, the growth of the labour force has outstripped the growth of the net capital stock; that is, when the net capital stock growth is adjusted for labour, the growth becomes negative. Over a substantial part of the study period, the growth in the provincial labour force far exceeded the growth in the capital stock of the province. This is not surprising considering that the growth in the provincial labour force was 311 percent between 1961 and 1999 while the increase in net capital stock in the province was 181 percent over the same period.

Figure 8: Net Capital Growth Corrected for Growth in Labour in Alberta, 1966 to 1999



Between 1982 and 1991, the growth in Alberta's net capital stock outweighed the growth in the labour force by a substantial margin. This is the result of substantial investments in capital stock (up to a nine percent annual increase) and relatively small increases in the provincial labour force (no more than two percent over the period). More recently, Alberta has experienced significant increases in labour force participation and smaller increases in net capital stock. Indeed, net capital stock actually declined for four consecutive years from 1994 to 1998, but has since leveled off.

5 Conclusion

This analysis looked at three main areas related to household and public infrastructure in Alberta. First, the value of services from households rose steadily over the study period, likely the result of increased investments by Albertans in household infrastructure; this is apparent from the steady increase in the cost of household infrastructure between 1961 and 1999. Second, the value of services from public infrastructure declined in the 1990s in Alberta. This is not surprising given the limited new investment in public infrastructure in the province recently. Finally, the growth of net capital stock in Alberta was corrected to account for the labour growth in the province, to discern whether the growth in capital has been enough to support a growing provincial labour force. This investigation revealed that the province's net capital stock grew enough from the early 1980s to the early 1990s to keep pace with a growing provincial labour force, but this is no longer the case. Recent investments in capital stock are not enough to support the booming economy. From a sustainability point of view, this means that future workers in Alberta may not have the levels of infrastructure needed to support production of goods and services. To achieve a sustainable balance between net capital stock and labour force, either the growth in net capital investment will need to increase, or the growth in the labour force will have to decline.

Appendix A. List of Alberta GPI Background Reports

A series of Alberta GPI background reports accompanies the *Alberta Sustainability Trends 2000* report and this report. These documents are being released in late 2001 and early 2002 and will be available on the Pembina Institute's website at www.pembina.org.

Alberta GPI Background Reports and Sustainability Indicators

GPI Background Reports	GPI Accounts Covered by Report
1. Economy, GDP, and Trade	• Economic growth (GDP) • Economic diversity • Trade
2. Personal Consumption Expenditures, Disposable Income and Savings	• Disposable income • Personal expenditures • Taxes • Savings rate
3. Money, Debt, Assets and Net Worth	• Household debt
4. Income Inequality, Poverty and Living Wages	• Income distribution • Poverty
5. Household and Public Infrastructure	• Public infrastructure • Household infrastructure
6. Employment	• Weekly wage rate • Unemployment • Underemployment
7. Transportation	• Transportation expenditures
8. Time Use	• Paid work time • Household work • Parenting and eldercare • Free time • Volunteerism • Commuting time
9. Human Health and Wellness	• Life expectancy • Premature mortality • Infant mortality • Obesity
10. Suicide	• Suicide
11. Substance Abuse; Alcohol, Drugs and Tobacco	• Drug use (youth)
12. Auto Crashes and Injuries	• Auto crashes
13. Family Breakdown	• Divorce
14. Crime	• Crime
15. Gambling	• Problem gambling
16. Democracy	• Voter participation
17. Intellectual Capital and Educational Attainment	• Educational attainment
18. Energy (Oil, Gas, Coal and Renewable)	• Oil and gas reserve life • Oilsands reserve life
19. Agriculture	• Agricultural sustainability
20. Forests	• Timber sustainability • Forest fragmentation

GPI Background Reports	**GPI Accounts Covered by Report**
21. Parks and Wilderness	• Parks and wilderness
22. Fish and Wildlife	• Fish and wildlife
23. Wetlands and Peatlands	• Wetlands • Peatlands
24. Water Resource and Quality	• Water quality
25. Energy Use Intensity, Greenhouse Gas Emissions and Air Quality	• Energy use intensity • Air quality-related emissions • Greenhouse gas emissions
26. Carbon Budget	• Carbon budget deficit
27. Municipal and Hazardous Waste	• Hazardous waste • Landfill waste
28. Ecological Footprint	• Ecological footprint

Appendix B. Infrastructure Data

Year	Household Infrastructure Service Value per Capita	Household Infrastructure Service Value Index	Public Infrastructure Service Value per Capita	Public Infrastructure Service Value Index
1961	828.34	42	456.56	67
1962	845.51	43	460.68	68
1963	873.75	44	458.36	68
1964	907.43	46	455.18	67
1965	956.39	49	459.96	68
1966	1,003.78	51	472.45	70
1967	1,055.98	54	484.71	71
1968	1,078.99	55	488.16	72
1969	1,125.32	57	489.50	72
1970	1,109.40	56	491.21	72
1971	1,138.51	58	491.46	72
1972	1,208.02	61	482.09	71
1973	1,305.37	66	487.57	72
1974	1,459.72	74	497.47	73
1975	1,491.91	76	512.87	76
1976	1,567.80	80	518.06	76
1977	1,617.03	82	526.43	78
1978	1,670.01	85	529.44	78
1979	1,750.79	89	532.05	78
1980	1,781.62	91	536.67	79
1981	1,743.11	89	559.39	82
1982	1,604.85	82	583.47	86
1983	1,559.75	79	592.22	87
1984	1,577.05	80	604.48	89
1985	1,635.98	83	627.76	92
1986	1,764.80	90	645.21	95
1987	1,815.44	92	654.74	96
1988	1,924.67	98	668.78	99
1989	1,965.27	100	674.83	99
1990	1,894.07	96	678.93	100
1991	1,794.29	91	671.64	99
1992	1,753.76	89	662.71	98
1993	1,748.95	89	651.14	96
1994	1,756.74	89	642.45	95
1995	1,737.13	88	630.04	93
1996	1,719.67	88	615.71	91
1997	1,739.33	89	598.70	88
1998	1,810.05	92	583.60	86
1999	1,866.13	95	571.39	84

Source: Household data from Statistics Canada, National Balance Sheets, Table 378-0004, Public data from Statistics Canada, personal communication.

Appendix C. U.S. GPI Services from Household Capital Methodology[3]

Data Sources:

Bureau of Economic Analysis (BEA). 1998. *Survey of Current Business* September 1998: Table 1, p.37. Table titled "Current-Cost Net Stock of Fixed Reproducible Tangible Wealth 1925-97."

Bureau of Economic Analysis. 1998. *Survey of Current Business* September 1998: Table 1, p.37. Table titled "Chain-type Quantity Indexes for Net Stock of Fixed Reproducible Tangible Wealth, 1925-97."

Bureau of Economic Analysis. 1997. *Survey of Current Business* July 1997.

Calculation:

The Bureau of Economic Analysis (BEA) periodically publishes estimates of the value of the stock of durable goods in households (for example, household infrastructure including refrigerators, stoves, microwaves, dishwashers, washers and dryers). Data from 1925 to present are available the *Survey of Current Business*, September 1998, p. 37, Table 1 ("Current-Cost Net Stock of Fixed Reproducible Tangible Wealth").

These figures are reported in current-cost dollars (column B), which are converted to 1992 chained-dollars (column C) using the chain-type price deflators for durable goods (column E).

Estimate Annual Services

After converting the stock of durable goods estimates into 1992 dollars we multiply these figures by 22.5 percent, of which 15 percent represents depreciation and 7.5 percent interest expense [column C x 0.225 = column D].

Deflator

To convert the current-cost estimates of consumer durable net stocks to 1992 chained dollars, we use the 1992 chain-type price index for durable goods.

The BEA produced estimates of depreciation, service lives, declining balance rates for various private sector, residential (household) and government asset classes in its July 1997 *Survey of Current Business*. This provides good estimates of rates of depreciation of durable goods owned by consumers. Depreciation rates range from 11.8 percent for furniture/beds, 15.0 percent for kitchen and household appliances, 18.3 percent for computers, video and audio equipment, to undisclosed rates for automobiles.

Data for net stock of fixed durable goods/assets owned by consumers in current-cost terms came from September 1998 *Survey of Current Business*, Bureau of Economic Analysis. Figures for 1925-1997 are expressed in current dollars and a chain-type quantity index is used for deflating these figures to 1992 chained dollars.

Rationale:

Economists have long agreed that a measure of annual income or output should measure the flow of services from the stock of capital rather than expenditures on capital. (In other words, it is more meaningful to use an accrual basis instead of a cash basis.) There is no agreement, however, on precisely how the stock should be measured or on how the value of the flow of services should be treated.

For purposes of predicting consumer behaviour during various phases of the business cycle, a refined treatment of the issue is important. For the purposes of the GPI, which is primarily oriented toward long-run trends rather than short-run changes in the economy, a rough estimate of the flow of services from consumer durables is sufficient.

The money spent on durable items, such as a refrigerator or stove, is not a good measure of the actual value consumers receive from these. It is important to take account, as well, of how long the item lasts. For example, when you buy a car or a refrigerator, you do not "consume" it in one year. The appliance (or "consumer durable") continues to provide service for a number of years. If it wears out quickly, the household has to replace it more often. The new purchase drives up the GDP; but the household would have been better off—that is, it would have obtained more value—if the appliance had lasted longer.

Accordingly, the GPI treats services received each year from consumer durables as benefits and the initial purchase price of those durables as a cost. This column adds the annual services that flow from consumer durables, which economic theory defines as the sum of the depreciation rate and the interest rate.

If a product lasts eight years, it depreciates at 12.5 percent per year and thus provides that much of its service each year. At the same time, if the interest rate is five percent, the purchaser of the product could have obtained that much interest by putting the money into the bank instead. Economists therefore regard the interest rate as part of the monetary value of the product to the consumer.

Based on an assumed depreciation rate of 15 percent and an average interest rate of 7.5 percent, the value of services of consumer durables is therefore estimated to be 22.5 percent of the net stock of cars, appliances, and furniture at the end of each year. Column L subtracts the actual expenditures on consumer durables to avoid double counting.

Focusing on the annual service that equipment provides rather than on the purchase price, corrects the way the GDP treats money spent as if it were the same as value received. It reflects the reality that, dollar per dollar, products that wear out quickly render less value than those that last longer.

Appendix D. U.S. GPI Value of Services of Streets and Highways Methodology

Data Sources:

Bureau of Economic Analysis (BEA). 1998. *Fixed Reproducible Tangible Wealth in the United States, 1925-89*. http://www.bea.doc.gov/bea/uguide.htm

Data for 1990-1997 are from the BEA website. http://www.bea.doc.gov

Calculation:

The BEA now reports government capital (net stock of highways and streets) for federal, state, and local government infrastructure in both current-cost basis and chained 1992 dollar basis (using a special chain-type price deflator for government construction, expenditures and gross investment to convert to 1992 chained dollars.)

Estimated Services

Multiply the current-cost estimates for the net stock of government streets and highways infrastructure (column B) by 0.075 (7.5 percent) to impute the annual services from the net stock (column C).

Deflator

Convert the imputed annual services (in current dollars) to 1992 chained dollars by dividing through by the ratio of the chain-type price deflator for government construction expenditures and gross investment over 100 (column C/(column E/100).

Rationale:

The GPI does not include most government expenditures. The main reason is that these are largely defensive in nature—they protect against the erosion of quality of life, rather than enhancing that quality. (This is literally the case regarding the largest government service outlay, defense.) In the GPI, the stock of government capital that provides services directly to households is assumed to include only streets and highways.

A great deal of other services provided by nonmilitary government equipment shows up in Column D—as personal consumption of services for which user charges are paid (such as transit, sewage, garbage collection, and so on).

Comments:

This calculation was made easier by the time series from BEA for the current net stock estimates for government dating back to 1947, thus eliminating the need in the original GPI to extrapolate data points.

Appendix E. Australia GPI Services from Public Capital Methodology[4]

The discussion of this component should be considered in conjunction with the discussion of net capital growth in Column Z. There we note that the services of private capital stocks are reflected in the national accounts through the prices paid by consumers for goods and services produced by firms using the capital. In the case of public capital stocks, where these stocks are owned by public trading enterprises which sell goods or services to consumers—such as electricity, gas, water and publicly owned housing—the services rendered each year by the capital are captured in the national accounts in consumption spending (directly in final consumption or indirectly to the extent that these items are purchased by firms as intermediate inputs).

This leaves us with the capital stocks owned by government and provided free of charge to the public. A time series for the stock of public capital was constructed from the Reserve Bank of Australia (RBA) 1996, Table 5.23 and Table 8 of ABS (Australian Bureau of Statistics) 5221.0. The estimates for 1995-1999 were calculated by inflating the stock by the real growth rate of the net capital stock using the chain volume measures given in Table 4.8 of ABS 5204.0. For the year 2000 the average of the growth rates in 1998 and 1999 was used.

However, the story does not end there. Some part of this capital stock will have been created to sustain various defensive expenditures discussed in Section 2.5 and Column D above. Thus their services to national welfare should be excluded from the GPI. Data for attributing capital investments by function are not available, so (bearing in mind that only 45 percent of public capital is owned by general government as opposed to public enterprises) we assume that the services of only 25 percent of publicly owned capital stocks should be added to the GPI. In other words, the benefits conferred by this public investment contribute to national welfare and have not been accounted for elsewhere in the GPI.

We must now ask how much this public capital contributes to national well-being each year. These forms of capital are assessed by the ABS as having life spans of around 50 years (Walters and Dippelsman 1985[5]), so, if we assume a straight-line depreciation function, these capital stocks contribute two percent of their value each year. Cobb, Halstead and Rowe (1995)[6] argue that we should also include the opportunity cost of funds tied up in these fixed assets and apply an interest rate of 7.5 percent. A real interest rate of five percent is closer to the cost of capital for government, and is the one used here. This means that the community benefits each year to the tune of seven percent of the non-defensive freely provided stock of public capital.

All of the capital stock must be maintained to ensure that income flows are sustainable, including the part devoted to defensive purposes. In its absence, the welfare of future generations would decline.

Appendix F. Australia GPI Net Capital Growth Methodology

The notion of Hicksian income requires that the value of a nation's capital stocks be maintained. Capital stocks yield two potential benefits: they contribute to the current year's production of goods and services (measured by their depreciation), and they contribute to the sustainability of income for future generations. We consider each of these, beginning with the latter.

In the GPI, the sustainability function is measured by net capital growth (i.e., net of depreciation). Thus the net capital stock is estimated from changes in the series of capital stocks net of depreciation adjusted to account for growth in the labour force. Estimates of the real value of the net capital stock for the years 1966-67 to 1993-94 are from RBA (1996: Table 5.23) and updated from ABS (Cat No. 5221.0) and ABS 5204.0 Table 4.9. For the years 1949-50 to 1966-67 we have extrapolated backwards from an index derived from estimates of Australia's capital stocks taken from Butlin (1977)[7]. Labour force data is from ABS 6203.0, Table 1. All capital stock data is smoothed using a five-year moving average, except for 2000, which is an average of the last two years, and 1999, which is a three-year moving average.

Let us now consider the annual services provided by the capital stock. The services of private capital stocks are reflected in the national accounts through the prices paid by consumers for goods and services produced by firms with the capital, so there is no need to consider it further. But what about the contribution of public capital stocks? Where these stocks are owned by public trading enterprises that sell goods or services to consumers—such as electricity, gas, water and publicly owned housing—the services rendered each year by the capital are captured in the national accounts in consumption spending (directly in final consumption or indirectly to the extent that these items are purchased by firms as intermediate inputs).

This leaves us with the capital stocks owned by government and provided free of charge to the public. These are discussed under Column J (Services of public capital). In summary, Column X is a measure of the annual growth in the value of the nation's built capital stocks net of depreciation and adjusted for growth in the labour force.

Endnotes

[1] Hamilton, Clive and Richard Denniss. 2000. *Tracking Well-being in Australia The Genuine Progress Indicator 2000*. Australia: The Australia Institute.
[2] Statistics Canada table 384-0035
[3] Anielski, Mark and Jonathan Rowe. 1999. The Genuine Progress Indicator – 1998 Update. Redefining Progress, San Francisco. March 1999. See http://www.rprogress.org/pubs/pdf/gpi1998_data.pdf
[4] Hamilton, Clive and Richard Denniss. 2000. *Tracking Well-being in Australia The Genuine Progress Indicator 2000*. Australia: The Australia Institute.
[5] Walters, R. and R. Dippelsman. 1985. *Estimates of Depreciation and Capital Stock Australia*. Australia Bureau of Statistics, Occasional Paper No. 1986/3.
[6] Cobb, C. T. Halstead and J. Rowe. 1995. *The Genuine Progress Indicator: Summary of Data and Methodology*. San Francisco: Redefining Progress.
[7] Butlin, M. 1977. *A Preliminary Annual Database 1900/01 to 1973/74*. Reserve Bank Research Discussion Paper No. 7701.