COLORADO'S GENUINE PROGRESS INDICATOR (GPI)

A Comprehensive Metric of Economic Well-being in Colorado from 1960-2011

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1/7/14

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THANKS AND ACKNOWLEDGEMENTS

We owe much gratitude to the researchers, colleagues and partners who helped get this project moving.

That includes Demos and Lew Daly for keeping the GPI momentum going stronger.

We need to give special thanks to Sean McGuire, Kenneth Bagstad and John Talberth.

We are also indebted to all the scholars who designed Maryland's GPI model, which was the scaffolding the Colorado GPI is modeled after. As well as the scholars behind the Utah GPI report which helped provide guidance adopting the GPI model for a mountain-region state.

Thanks to a few other colleagues that assisted in finding Colorado-specific data for the GPI and for giving us feedback and collaboration:

- Kyle Fritz at the National Transit Database
- John Elias at the Regional Transportation District (RTD).
- Joan Pinamont, CDOT Librarian
- Josh Drukenbrod, statistician at EPA
- Dr. Paula Cole and her University of Denver classes
- Sarah Wilhelm

ABSTRACT

This study calculates a new, more comprehensive metric to measuring economic well-being in Colorado known as the Genuine Progress Indicator (GPI). The standard proxy for measuring a state's economic well-being has been GDP (Gross Domestic Product), even though it was never intended to be a proxy for economic well-being. The GDP accounting method adds up all monetary transactions that occur in a given year. Being a broad measure of economic activity, GDP does not make any distinction between these activities, thereby counting "defensive expenditures" or "regrettable" transactions as positive that don't add to economic well-being. GPI also omits environmental externalities and ignores negative social conditions ranging from family breakdown to crime as well as positives like volunteerism, household labor and economic benefits from farms and forests.

The new metric, GPI, gets closer to the reality of economic well-being by establishing an accounting method that subtracts and adds factors that contribute and detract from Coloradans' economic welfare.

GPI starts with a proxy for material welfare — the amount of goods and services Coloradans themselves buy each year — known as personal consumption expenditures. This is then adjusted for income inequality, accounting for the fact that added consumption beyond the point of meeting basic needs provides increasingly less economic satisfaction. With adjusted personal consumption as the baseline, GPI adds the monetary value of activities that add to economic well-being but are not counted in the standard GDP framework. These include things like household labor, volunteer labor and benefits of higher education. GPI then subtracts the monetary cost of the expenditures that we incur to protect the depletion of our natural and social capital. These include things like the cost of auto accidents, costs of crime, lost leisure time and pollution. Twenty-four factors are included to generate the Colorado GPI for the years 1960-2011.

Executive Summary

Coloradans these days are working longer for less money, spending more time commuting to work and fewer hours with family. At the same time, there are more "underemployed" Coloradans than ever before. And the gap between the wealthiest and the poorest people in our state is the biggest it has been in at least 50 years.

That doesn't mean the Colorado economy hasn't grown steadily for the last several decades, however. If you just look at the state's Gross Domestic Product, or GDP, it appears Colorado has been doing better economically for the last half century. But is GDP really the right way to determine if most Coloradans themselves have experienced economic progress?

That's where GPI, or the Genuine Progress Indicator, comes in. GPI is a measure of economic well-being that is increasingly being used to gauge economic progress. GPI measures in economic terms what GDP can't — whether people's lives are improving.

If you were attempting to see how successful a business is, you wouldn't look only at gross revenues. You'd also look at expenses, things on the negative side of the ledger like payroll, capital costs, insurance, utilities and debt service. And if you were taking a smart look, you wouldn't just examine the things with obvious dollar amounts attached to them. You'd also measure things that were less visible but that still came with real costs attached, things like opportunity costs from certain business decisions. You'd probably also consider how sustainable a company's practices are.

In the same way, when you look at the economic well-being of a nation, or a state, you can't just look at the sum total of all economic transactions as the measure of how well off its residents are. But that's basically what GDP does. Even though GDP was never intended to measure economic well-being, it's commonly looked at that way. So, for example, if a house that has burned to the ground gets rebuilt, the money spent reconstructing that house is counted as a positive under GDP, even though you're just rebuilding the same house. You're no better off than you were before your house burned down.

For the last few decades, economists have been developing a measure that more accurately and thoughtfully addresses the question of whether the economic well-being of a population has increased or not. This more recent form of measurement, the Genuine Progress Indicator, has been used in several other states including Maryland, Utah, Vermont, Ohio and Minnesota, and there are efforts afoot in other states to measure GPI.

This study calculates GPI in Colorado using 24 recognized indicators that balance positive economic factors — things like net capital investment, hours spent volunteering, the value of higher education, highways and streets and the value of consumer durables —with negative ones, like the costs of crime, underemployment, pollution and income inequality.

What the study shows is that while Colorado's per capita GDP has tripled since 1960, GPI, expressed as a dollar figure per capita, has trailed behind significantly.

GPI is a more useful metric than GDP. One of the biggest limitations with GDP as a measure of economic well-being is that it counts "regrettable" or "defensive" expenditures the same way it counts other spending, even though these expenditures are often made simply to mitigate the way we live.

For example, more money that is spent on driving to work merely adds to GDP even though it also results in more time spent in traffic, which reduces time available to be spent on work, leisure or family. More money spent cleaning up pollution increases GDP even though this is merely a cost of mitigating the negative effects of another economic activity. Under GDP, if the size of the economy increases dramatically because a small number of people have become exceptionally wealthy, this is counted as a positive, even though it may mean staggering income inequality that leads to a lack of social cohesion and decreased consumption, the engine that drives the entire economy.

Under the Genuine Progress Indicator, these negative effects are assigned a dollar value that is subtracted from total personal consumption, resulting in a per capita sum that is more reflective of economic progress or well-being. In addition, GPI adds in certain positive factors to the economy that GDP does not account for, such as the value of volunteer hours, household labor and higher education.

GPI is calculated using three sets of indicators: economic, social and environmental. Some indicators add value while others subtract value.

Economic indicators include things such as the costs of underemployment and income inequality and the value of personal consumption. The economic components have the largest impact on GPI, making up a net positive of $116 billion.

Social indicators are things such as the value of volunteer hours and the costs of lost leisure time, crime and divorce. The social elements of the GPI add a net positive to well-being of $23 billion, the largest components being household work and the value of higher education.

Environmental indicators include things such as the costs of pollution, resource depletion and the loss of farmland, wetlands and forest cover. These environmental components contribute a net loss to Colorado's GPI by deducting $35.3 billion. More than half of the costs of environmental damage come from depletion of non-renewable energy sources.

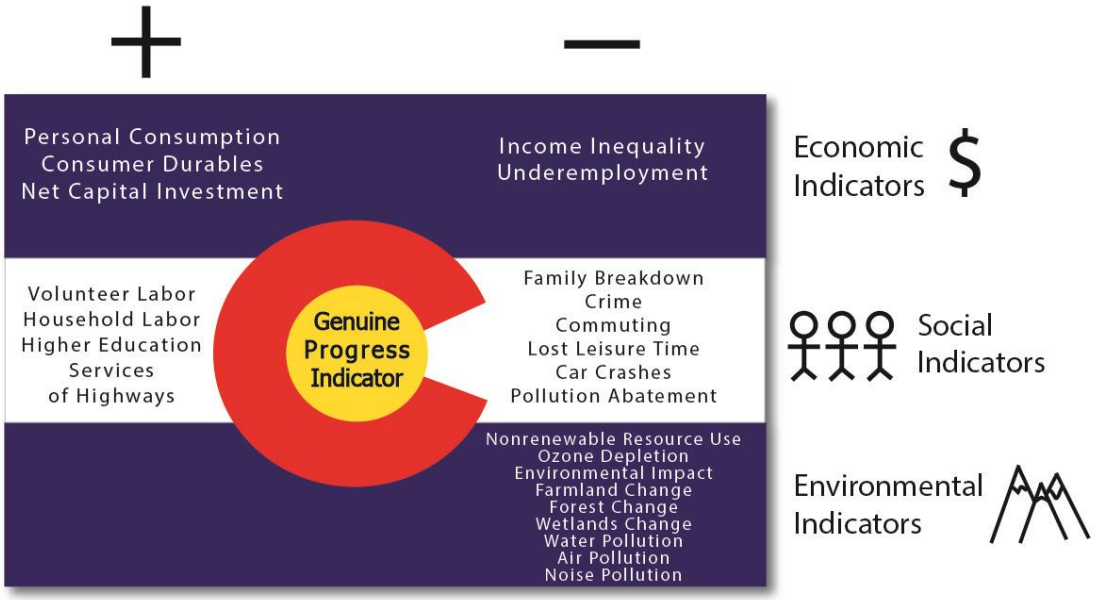


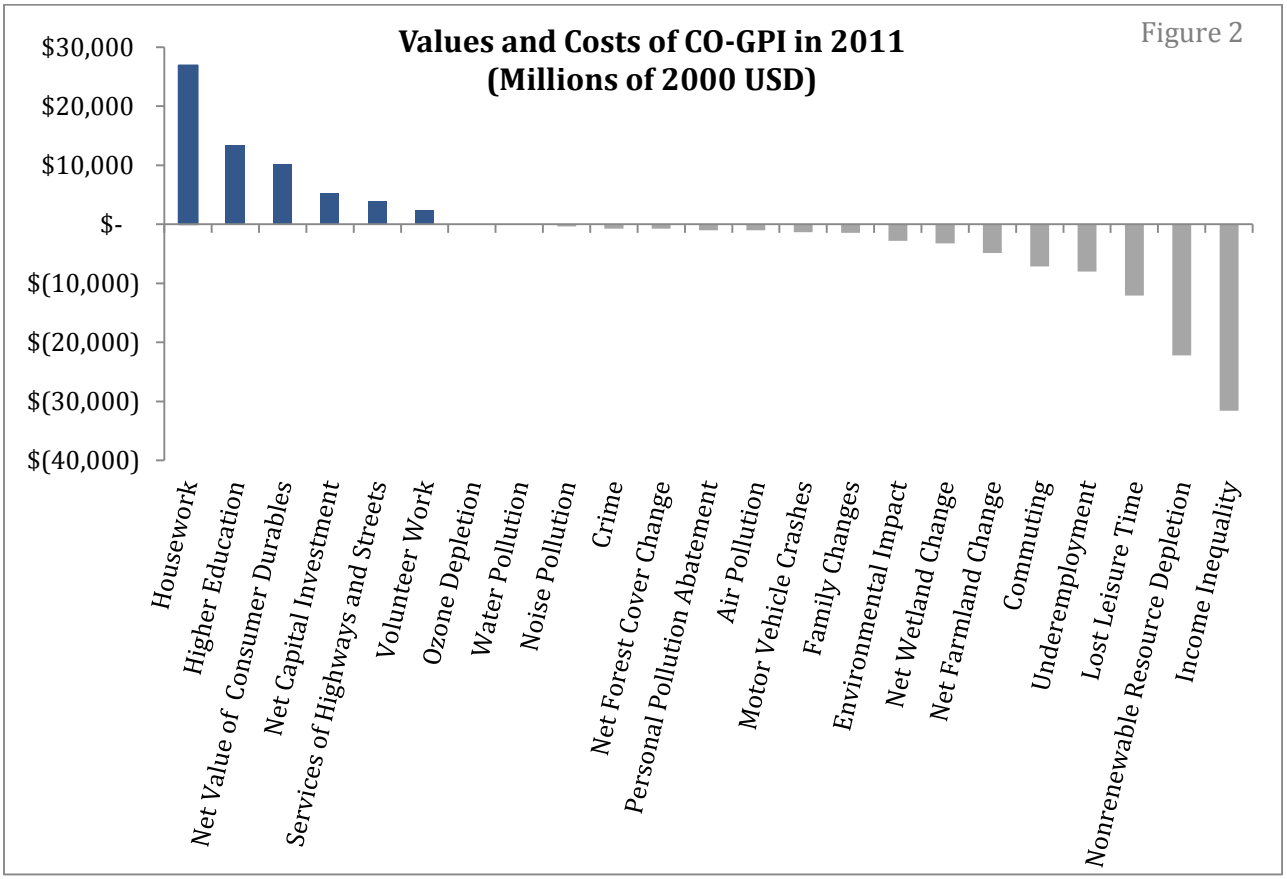
Figure 1. Economic, Social, and Environmental Components of the CO-GPI
The plus and minus signs denote whether the indicator makes a positive or a negative contribution to GPI.

Adding and subtracting these various indicators, this study shows that while Colorado's per capita GDP increased from $13,454 in 1960 to $40,206 in 2011, the state's GPI only increased from $9,366 in 1960 to $20,197 in 2011.

In essence, the state's economy tripled in size over the last 50 years while the economic progress of Coloradans only doubled. Much of the growth in GDP has come with costs that, prior to the development of the Genuine Progress Indicator, were not measured.

This study takes those costs into account along with previously unmeasured economic benefits and calculates GPI for Colorado.

Figure 2 shows the relative weights of the 24 components of GPI in Colorado in 2011.



CHAPTER 1: THE CASE AGAINST GDP

Most economic and budget policy decisions are viewed through the lens of economic growth, measured by GDP, or Gross Domestic Product. Behind those decisions lies the assumption that well-being is directly related to economic growth.

Looking at a standard measure of economic activity in Colorado, such as GDP, indicates there has been strong growth both in total value and in per capita terms the last several decades. In fact, real GDP per capita tripled in Colorado from 1960 to 2011. But does that really mean that the typical Coloradan is three times better off today than he or she was in 1960? While the consumption of goods and services has continually risen, income inequality has risen, average real hourly wages have declined and quality time spent with family has eroded. GDP has created a false illusion that the state is getting richer and the state's well-being is improving at a faster rate than it really is.

Everything is three times better today than in 1960, at least according to the default yardstick of economic well-being, GDP.

Although it has become a proxy for progress, GDP has many limitations that prevent the metric from correlating closely with economic well-being. Since its introduction, economists have warned that considering GDP a general indicator of well-being was dangerous (Kuznets, 1934, Kuznets et al., 1941).

GDP is a tally of all monetary exchanges that occur in a given year; it doesn't differentiate between economic purchases that add to our well-being and ones that undermine it. For example, rebuilding homes destroyed by forest fires actually add to GDP since all that money is spent in new construction. But this construction only gets us back to where we were before the fire and also diverts the goods and services used on reconstruction away from investments that would improve well-being in the future.

GDP also counts, as a positive, the expenditures made to protect people from the side effects of current and past economic activities. These dollars do not add to well-being; they only prevent its deterioration. Other GPI studies call these expenditures "defensive" since they are expenditures that "we have to make to protect ourselves from the unwanted consequences of the production and consumption of other goods by other people" (Daly and Farley 2004). Such an example would be the cost of disposing of garbage; such a purchase doesn't add to well-being but is necessary.

GDP does not consider the distribution of growth. If the size of the economy doubled but all that wealth went to only a handful of individuals, would the economic well-being of the typical Colorado family improve? Under the GDP accounting system, it would.

GDP does not take into account non-market activities like commuting time or lost leisure time. All Coloradans could suddenly decide to work 80-hour weeks and dramatically boost the number of dollars we earn and spend, although we'd be sacrificing 40 hours we would

have been spending with family and friends. The current GDP framework doesn't take into account lost time with families or lost leisure. Working 80-hour weeks would only be a positive.

GDP doesn't account for non-market services of the environment or the individual. All the hours Coloradans volunteer are not counted in GDP nor are the hours of household labor Coloradans perform every year.

GDP tells us nothing about sustainability. GDP counts the consumption of natural resources as strictly positive. So we could deplete all Colorado's mines and divert every drop of water to agriculture in one year to dramatically boost our state GDP, but it doesn't tell us whether production and consumption involve unsustainable activities. GDP doesn't account for negative externalities created by the way we live. So the damage from pollution is ignored.

Given the many limitations of GDP acting as a pure indicator of economic well-being, GDP can be viewed as a business reporting only total revenue while neglecting to subtract expenses or depreciation of company equipment. Another way to view the limitations of GDP is to think of GDP as a measure of economic *quantity*, not economic *quality* or welfare (Posner, 2010).

Prioritizing economic well-being instead of economic growth requires an alternative measure to GDP accounting.

GPI and Other Alternative Indicators

The GPI is an objective, composite index just like GDP. The difference is that GPI makes corrections to the existing GDP framework. It uses data sets about factors ranging from commute time, to volunteer hours, to number of college graduates, to acreage of forest land. Each indicator is translated into an objective dollar amount. With every factor in dollar terms, economic, social and environmental factors can be aggregated. For example, an hour spent volunteering is worth an hour's pay at Colorado's average volunteer wage rate. Each incident of breaking-and-entering crime costs $1,513 — the average of all B-and-E incidents — and is subtracted from the GPI. Having all of the components of GPI in dollar terms allows trade-offs to be shown — so an increase in a cost like pollution could be offset by an increase in a benefit like personal consumption.

The GPI should not be confused with subjective measures of happiness. We make the distinction between economic well-being and happiness here. The GPI does not directly measure happiness. It shows the potential for community well-being. The GPI is best thought of as a more comprehensive form of measuring economic progress that measures the total economy. The GPI does something completely different than indices that look at individuals. The methodology here follows what previous GPI studies have calculated.

There are many other indicators that keep track of changes in poverty, the economy, housing, education, health, crime and transportation. The GPI does not supplant these

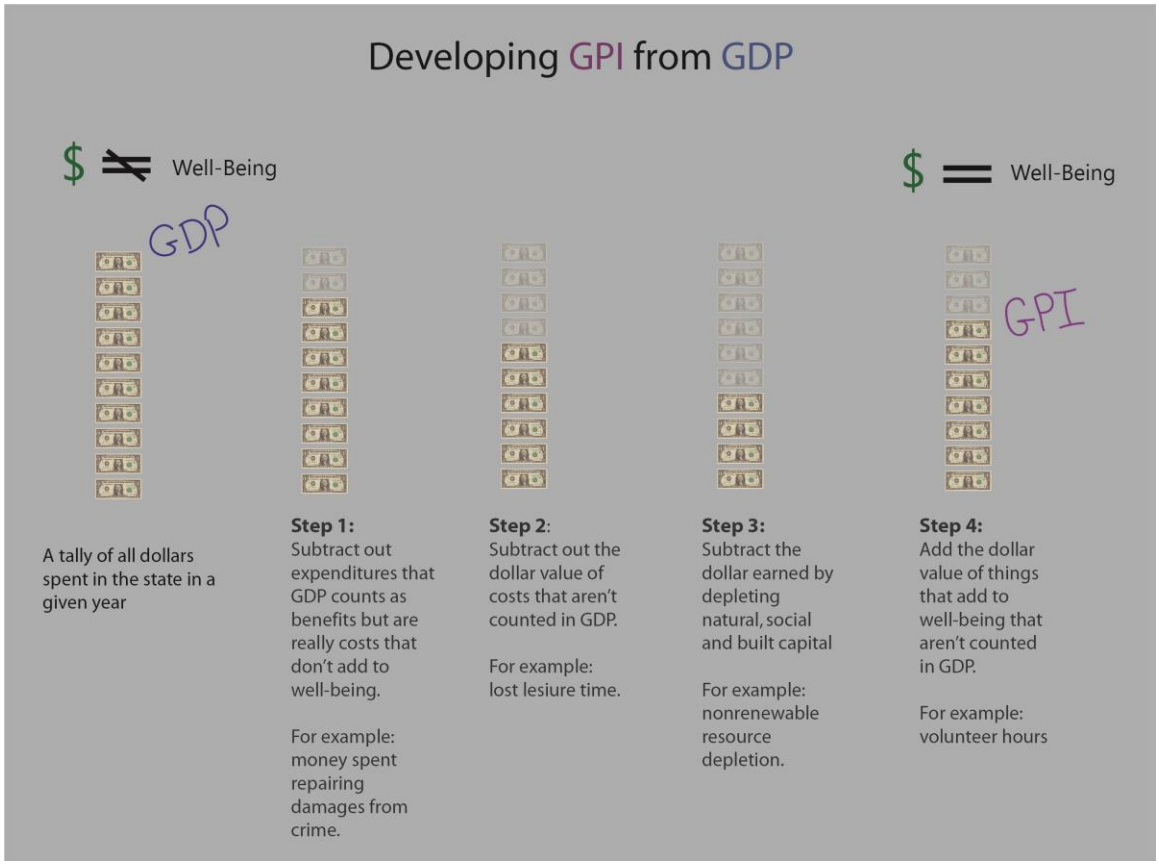
indicators, it simply contributes to the analysis of community well-being by offering a single numeric metric that incorporates a wide range of indicators.

The GPI is a More Comprehensive and Useful Indicator Than GDP

The Genuine Progress Indicator (GPI) provides a more comprehensive measure that attempts to correct many of the flaws of GDP accounting. At the most basic level, the GPI adopts an economic accounting system that starts with something like GDP but then adds those factors that contribute to economic well-being and subtracts the monetary value of factors that detract from it that are omitted in the GDP framework. It is one of the first alternatives to GDP vetted by the scientific community and used by governments to show economic welfare (Talberth et al., 2007).

The GPI attempts to equate dollars to economic well-being. All the dollars in GPI add to economic well-being because the "defensive" dollars are subtracted out. The dollars earned from over-utilizing resources are subtracted since they won't be around in the future. The dollar value of factors that add to our economic well-being but are currently omitted by GDP are added back in. The value of the negative externalities like pollution that aren't counted in GDP are subtracted.

Figure 3. Developing GPI from GDP



The overarching question that the GPI sets out to answer is: "Has the economic growth in Colorado over the past five decades led to social, economic and environmental progress?"

Adopting a GPI accounting metric in Colorado is meant to accomplish a number of goals:

- Identify opportunities for Coloradans to improve their economic well-being.
- Show how much "defensive" spending (expenditures that do not add to well-being but merely prevent its erosion) Coloradans undertake as a result of the way we live and consume.
- Assess whether economic well-being is improving and show the trends over time.
- Provide Colorado decision makers with a more comprehensive method to assess the full effects of public policy and budget decisions.
- Allow policy-makers to examine the trade-offs of allocating and using particular resources.

CHAPTER 2: HISTORY, THEORY, AND METHODOLOGY OF THE GENUINE PROGRESS INDICATOR (GPI)

The current GPI metric is a product of evolution since the first alternative was published in the 1970s. In 1972, as one of the earliest attempts to correct for the limitations of GDP, James Tobin and William Nordhaus created the Measure of Economic Welfare (MEW), which makes adjustments to GDP for typically unaccounted-for economic and social factors. The first adjustment was to subtract out the money spent on items that didn't add to well-being that were counted as positives in GDP. "Since GDP is a measure of production rather than of welfare, they count many activities that are evidently not directly sources of utility themselves but are regrettable necessary inputs to activities that may yield activity." (Nordhaus and Tobin, 1972). Next, values of leisure and household activities were added in. Adjustments were made for capital accumulation in order to account for the costs of depletion of capacity to yield future production. Finally, an imputed value of urban disamenities, or unfavorable qualities of city life — such as traffic congestion, pollution and crime — was backed out because "some portion of higher earnings of urban residents may simply be compensation for the disamenities of urban life and work" (Nordhaus and Tobin, 1972, page 12).

Another alternative index came out in the early 1980s known as the Index of the Economic Aspects of Welfare (Zolotas, 1981). It differed widely from the MEW by focusing on the current flow of goods and services and largely ignoring capital accumulation and sustainability. Both studies, despite their different methodologies, provided early evidence of the gap between GDP and well-being and quantitatively showing that more and more economic activity may be self-canceling from an overall well-being standpoint (Posner, 2010).

Then in the late 1980s, Herman Daly and Clifford Cobb developed the Index of Sustainable Economic Welfare (ISEW), which built upon the MEW but also included environmental costs. In the 1990s, the ISEW was adjusted by Cobb, Rixford, Halstead and Rowe. They referred to their product for the first time as the GPI.

There are a handful of states that have created local-level GPI studies: Maryland (Maryland Genuine Progress Indicator 2010, Posner 2010); Minnesota (Minnesota Planning Agency 2000); California (Bay Area Genuine Progress Indicator 2006); Ohio (Bagstad and Shammin 2012); Utah (Berik and Gaddis 2011); Vermont (Costanza et al., 2004 and Bagstad and Ceroni, 2007); and Hawaii (Hawaii State Environmental Council 2013).

How Does the GPI Define Progress?

How we define progress determines how and where society allocates its collective efforts. The notion that economic growth represents general societal progress causes many problems. Defining progress based solely on economic growth in GDP has led to a situation

where high economic growth rates are achieved at the expense of other forms of progress, such as mental and physical well-being, clean air and water or cohesive communities.
The GPI defines progress differently than the standard economic idea of progress. The GPI adopts the notion of progress from a relatively new branch of economics: ecological economics, which emphasizes the goals of achieving optimal scale, fair distribution and efficient allocation of resources instead of simple economic growth (Daly and Farley, 2004).

The comparisons made in Table 1 are adopted from Posner (2010), which are based on Bagstad (2008) and which help contrast the approach of ecological economics and standard economics.

Table 1: A New Paradigm to Measure Progress

	Neoclassical Economics	**Ecological Economics**
Definition of Progress	• Increased consumption of resources • More is always better	• Increased quality of life • Meeting of human needs • Sustainable and desirable economy
Underlying Belief System	• Unlimited resources • Substitutability between capital	Resources are limited which limits the desirability of economic scale
Goal	• Efficient allocation of resources • Fair distribution of resources	• Sustainable scale for the economy • Fair distribution of resources both within and between generations • Efficient allocation of resources
Method of Measurement	Gross domestic product (GDP)	Genuine Progress Indicator (GPI)

Theory of Evaluation Behind the GPI

The foundation of GPI comes from the concept of "welfare-equivalent income," first articulated by Irving Fisher (1906). The central idea is that households derive welfare from their consumption activities. A consumption definition of income moves the emphasis from the goods that are produced to the benefits and services those goods provide to consumers.

The GPI includes consumption activities that contribute to well-being but deducts the amount spent on purchasing, maintaining and replacing durable goods. For example, the GPI doesn't consider the purchase of a durable good such as a car as income but counts the

benefits that the car gives over its lifetime. It's best to think of "welfare-equivalent income" in the net sense (Lawn, 2003).

The GPI model is based on the principle of non-declining stock of built and natural capital. This stock of capital must be available for future generations. So deductions are made in the GPI model to account for declining natural and built capital.

The philosophy behind the environmental components of the GPI is based on the principal of "strong sustainability" (Lawn 2003, Talberth 2007, Baumgartner and Quaas 2009). This means that there is a limit to the extent to which built capital — buildings, bridges and other manmade objects — can substitute for depleted natural capital, resources such as timber, farmland and water. Thus, to keep the stock of natural capital intact, the cost of natural resource depletion must be factored into an evaluation of well-being (Berik and Gaddis, 2011). The current GPI actually measures "weak sustainability" because we can be losing environmental or social capital if we're growing built capital at a fast enough rate. This is an ongoing critique of the GPI that the scientific community is working out.

The social domain of the GPI is based on the notion that the quality of social life is integral to well-being and must be sustained into the future. Therefore, GPI values the many unpaid activities that sustain and build families and communities.

Components of GPI

The GPI is measured in dollars. The GPI model aggregates the various indicators into a single number with dollars as the denominator. Hence, the model must assign monetary units to environmental and social indicators (the economic indicators are mostly already captured in dollars). For example, an acre of farmland is assigned a dollar value to represent what that acre contributes to society. If that acre is lost, the value of that acre subtracts from GPI.

Assigning a dollar value to non-market items is inherently challenging, but is necessary to establishing relative worth among resources managed by society (Hawaii State Environmental Council, 2013). The model used the best possible estimates from peer-reviewed valuation studies.

Since GPI is reported in a single number for each year, it makes communicating with the public much simpler and it can be compared with other metrics more readily. The GPI can also be broken down into its components and analyzed in depth. For instance, environmental groups can look at the sub-component environmental indicator which can further be scrutinized down to the forest indicator.

The GPI framework starts with personal consumption expenditures — which can be thought of simply as the amount of goods and services Coloradans themselves buy each year. This is then adjusted for income inequality. With adjusted personal consumption as the baseline, GPI adds the monetary value of activities that add to economic well-being but are not counted in the standard GDP framework. These include things like: household labor,

volunteer labor and benefits of higher education. GPI then subtracts the monetary cost of the expenditures that we incur to protect the depletion of our natural and social capital. These include things like: cost of auto-accidents, costs of crime, lost leisure time and pollution. It also subtracts the money Coloradans spent on items that must be spent to abate the negative outcomes that result from the way we live and consume. For example, money spent to dispose of our waste.

These 24 indicators, in Table 2, fall into three categories: economic, environmental and social.

Table 2: Components and Methods of Calculation for Colorado's GPI

Indicator	Impact on Well-Being	Description	Formula
A. Personal Consumption Expenditure	+ baseline	Starting point for GPI.	Personal Income multiplied by the national ratio of consumption to income spending.
B. Income Distribution	+ or -	Severe income inequality has social and economic costs not captured by the GDP.	Gini coefficient in year divided by Gini coefficient at baseline low value multiplied by 100.
C. Inequality-adjusted Consumption Expenditure		Becomes the baseline from which other GPI components are added or deducted.	Row A divided by Row B.
D. Benefits of Consumer Durables	+	Estimates the services provided by household equipment, which is a more accurate measure of value that just the money spent on such long-term items.	20 percent of stock of consumer durables.
E. Cost of Consumer Durables	-	The price of durables is subtracted to avoid double counting the value in their services and personal consumption.	Personal Income multiplied by national percentage of spending on consumer durables.
F. Underemployment	-	Involuntary part-time workers, discouraged workers and the chronically unemployed represent reduced well-being.	Underemployed persons multiplied by unprovided work hours per constrained worker multiplied by average hourly wage.

G. Net Capital Investment	+ or -	To avoid consuming its capital as income, a state must increase or at least maintain the supply of capital for each worker to meet the demands of the future labor force.	Net stock of private nonresidential fixed reproducible capital minus the capital requirement, which is the amount necessary to maintain the level of capital per worker.
H. Water Pollution	-	Impairment of water systems create loss to society but are ignored by GDP.	Total benefit of unimpaired waters multiplied by the percentage of streams, rivers, and lakes that are impaired.
I. Air Pollution	-	Money spent to repair damage to health, infrastructure and environment from poor air quality is ignored by GDP.	Emissions of particulate matters, Nitrogen Oxide, Sulfur Dioxide and Volatile Organic Chemicals multiplied by their respective costs per ton.
J. Noise Pollution	-	The World Health Organization (WHO) produced an estimate for damaged caused by noise pollution in U.S.	Ratio of Coloradans living in cities compared to Americans living in cities multiplied by the WHO cost of noise pollution.
K. Wetland Change	+ or -	The value of ecosystem services provided by wetlands like flood control, purified water and dust suppression are not counted in GDP.	Acres of lost or gained wetland multiplied by value per acre.
L. Farmland Change	+ or -	Trading farmland for urbanization creates costs like reduced local food supply that aren't captured in the GDP.	Acres of lost or gained farmland multiplied by the farmland value per acre.
M. Forest Cover Change	+ or -	Losing services like flood control, wildlife habitat and recreation from lost forest land are not captured in GDP.	Acres of forest land lost multiplied by value of forests per acre.

N. Environmental Impact	-	GPI tries to quantify the costs from environmental damage associated with climate disruption.	Consumption of energy multiplied by the marginal social cost of carbon dioxide emissions associated with each energy source.
O. Ozone Depletion	-	GPI captures the economic costs of increased exposure to harmful solar radiation.	Chlorofluorocarbon (CFCs) emissions multiplied by cost per ton.
P. Nonrenewable Resource Depletion	-	Depleting nonrenewable resources creates costs for future generations. The GPI tabulates their cost in the year in which they get used.	Consumption of coal, natural gas, and petroleum multiplied by the cost to replace that energy with renewable resources.
Q. Value of Housework	+	An important economic activity that is omitted in GDP which includes meal preparation, cleaning, repairs, and parenting.	Total hours of household work multiplied by the wage one would pay to hire someone else to do that equivalent work.
R. Family Breakdown	-	GDP counts the money spent on divorces as positive as well as traditional family bonding activities that are moved to the market economy like babysitting.	Costs of divorce on parents and children plus the societal cost of television viewing.
S. Crime	-	Harms well-being from medical expenses and damaged property as well as non-monetary mental costs to the victims.	Monetary costs of each crime plus the non-monetary costs to the victims.
T. Pollution Abatement	-	Money spent to restore quality back to a baseline doesn't add to well-being so spending on air filters and waste treatment only compensate for externalities created by our economic activity.	Spending on automotive air filters and catalytic converters plus the cost of sewage plus the cost of solid waste disposal.

U. Volunteer Work	+	Another activity omitted in GDP since no money is exchanged, but nonetheless is an important part of community well-being.	Total hours of volunteer work multiplied by the average hourly wage for volunteers.
V. Lost Leisure Time	-	GPI counts all work as a positive without accounting for the tradeoff of leisure.	People employed multiplied by each year's lost leisure compared to a baseline year multiplied by the average hourly wage rate.
W. Higher Education	+	The GPI captures the indirect personal and societal benefits of an educated population.	Bachelor's degree holders multiplied by the social benefits per bachelor's degree holder.
X. Services of Highways	+	These services are provided by the government but could be sold. Assumes 75% of miles are driven for pleasure and 10% of net stock is annual value.	7.5% of net stock of highways and streets
Y. Cost of Commuting	-	Commuting adds costs that don't necessarily add to well-being but must be done.	Miles traveled to work multiplied by the cost per mile for vehicle use, added to the hours spent commuting multiplied by a reduced wage rate, added to spending on public transport fares.
Z. Car Accidents	-	GDP counts the money spent on property and health damage from car crashes as a positive. GPI corrects for this.	Number of fatal accidents, injury accidents and property-damage-only accidents multiplied by their respective costs.

CHAPTER 3: ECONOMIC COMPONENTS OF THE GPI

Personal Consumption

The foundation or starting point for calculating the GPI is personal consumption spending by households on goods and services. GDP, which displays the total monetary value of what is *produced*, does not reveal what a Colorado household *consumes*. Since it is ultimately the consumption of goods and services that brings about material welfare, measuring personal consumption is the appropriate starting point for an indicator of well-being.

Personal Consumption Expenditure, as the metric is known, is not unlike GDP since personal consumption makes up about 70 percent of GDP. Everything that households spend their money on: groceries, clothes, childcare, healthcare, education, transportation, recreation and entertainment, etc., is counted in personal consumption. As the starting point, personal consumption is the baseline measure from which all other factors in the GPI are added or subtracted.

The Bureau of Economic Analysis (BEA) does not measure personal consumption data at the state level. It does however measure personal income. Thus, GPI studies use the national ratio of consumption to income and state-level data on personal income to derive state-level consumption statistics.

In Table 3 we derive personal consumption each decade as an example. Starting with personal income (BEA) which is adjusted for inflation into 2000 dollars, we multiply by the average U.S. ratio of consumption to income — also known as the propensity to consume — to get personal consumption per capita for Colorado.

It should be noted that all indicators used in the Colorado GPI are in real 2000 dollar values.

TABLE 3. DERIVATION OF PERSONAL CONSUMPTION PER CAPITA (2000 USD)

	1960	1970	1980	1990	2000	2010
Personal Income per capita Colorado	$13,562	$17,930	$22,390	$25,530	$33,986	$33,249
Ratio, Income-Consumption: U.S.	78%	75%	76%	78%	79%	82%
Personal Consumption per capita Colorado	$10,644	$13,432	$16,957	$19,914	$26,777	$27,278

Source: Bureau of Economic Analysis

As Table 4 illustrates, consumption per capita has almost tripled since 1960. Colorado is a fairly wealthy state — ranking 16th in personal income per capita in 2011. In recent decades, Colorado has been among the wealthier states. Colorado was the 14th wealthiest state in 1960.

TABLE 4. WHERE COLORADO RANKS: PERSONAL INCOME PER CAPITA (2000 USD)						
	1960	1970	1980	1990	2000	2010
U.S.	$13,194	$18,125	$21,088	$25,499	$30,319	$31,714
Colorado	$13,561	$17,930	$22,390	$25,530	$33,986	$32,941
Rank	14	18	13	19	7	16
Source: Bureau of Economic Analysis						

Income Inequality

Income inequality describes the income differences between Colorado households. It is often referred to as the "gap between the rich and the poor." It measures how much income a particular portion of Colorado households have compared to another portion.

Measuring Income Inequality: GINI

The Gini Index, a statistical measure of income dispersion, measures the difference between actual income distribution and equal distribution by quintiles (one-fifth of population). It computes detailed aggregate income data of Colorado into a single statistic and is used to measure household income inequality. The values range from 0 to 1, with 0 representing perfect equality and 1 representing perfect inequality (where one household receives all of the income). Thus the higher the Gini index, the greater the income inequality. Values in the range 0.20 to 0.30 signify low levels of inequality.

Income inequality is important for measuring well-being for several reasons. If inequality becomes too extreme, it can harm social cohesion, which leads to large gaps between those at the top and those feeling left behind. Empirical evidence shows that rising income inequality hinders growth in economic welfare (Hsing, 2005). Income inequality can harm economic welfare by increasing crime, reducing worker productivity and dampening investment. Inequality can also create a loss of potential economic output for society from the unequal opportunities for investment (Todara and Smith, 2009). This occurs, for instance, when lower-income families cannot set up businesses because of lack of credit or provide adequate education to their kids. This can ultimately lead to lower future economic potential for the entire state.

In addition, growth in consumption yields different benefits to individuals of different income levels. Because of the law of diminishing returns, wealthier groups gain less from a given increase in income compared to lower-income groups. (For example: a sandwich given to someone who has already eaten lunch has less value than the same sandwich given to someone who hasn't eaten all day). Because lower-income groups will profit more from the same increase in income than the already wealthy, it makes a difference who receives the additional income when it grows.

Some degree of income inequality is a necessary part of a capitalist society because it acts as a signal of the rewards possible for those who work hard and take risks. Extreme inequality, however, can be a detriment. More and more research suggests that increasing inequality creates a drag on economic growth (Stiglitz, 2013; Furman and Stiglitz, 1998; Deininger and Squire 1998; Reich, 2010; Breen, 1997) creates other psychological and indirect costs

(Frank, 2000; Wilkinson 2010; Wisman 2011) causes increased poverty (Iceland, 2003) and makes the economy more susceptible and more vulnerable to economic crises (Wisman, 2013; Georgopoulos et al, 2010; Holt and Greenwood 2012). Others argue that income inequality in a given year is not such a bad thing as long as there is upward mobility in society. If families in lower-income groups can advance to high-income groups, then inequality isn't necessarily terrible. This is a valid point; assessing inequality should be considered in the context of upward societal mobility. Recent survey evidence shows that Americans dramatically underestimate the level of income inequality and show a desire for a more equal distribution of wealth than the status quo. (Norton and Ariely, 2011).

Income distribution is factored into the GPI from the notion that inequality directly relates to social cohesion and economic welfare which is predicated on the assumption that inequality represents a social cost (Anielski and Rowe, 1998). The Colorado GPI incorporates income inequality by discounting personal consumption expenditures by the amount of inequality in each year using an income distribution index. GPI does this by choosing the year in which inequality was lowest and using deviations from that base year to weight personal consumption. This method assumes that, from an economic well-being perspective, the lowest level of income inequality is the best condition. The year 1970 was used as the base year in previous GPI studies since it was the year in which the U.S. experienced the lowest levels of income inequality. To maintain comparability with other state-level GPI studies, we also indexed Colorado's Gini coefficients with the base year 1970 set to 100, even though Colorado had its lowest level of inequality in 1962. Since Colorado had a few years before 1970 with lower income inequality, the adjusted personal consumption is actually higher than personal consumption in some of those years.

See Table 5 for calculations. Column C equals column A divided by column B. As inequality grows, adjusted personal consumption shrinks — reducing well-being.

TABLE 5. ADJUSTING PERSONAL CONSUMPTION FOR INCOME INEQUALITY

		1960	1970	1980	1990	2000	2010
A	Personal consumption per capita Colorado	$10,644	$13,432	$16,957	$19,914	$26,777	$27,278
B	Indexed GINI coefficient	95	100	108	125	131	129
C	Adjusted personal consumption	$11,211	$13,432	$15,679	$15,908	$20,464	$21,214

Figure 4 shows personal consumption and adjusted personal consumption (adjusted for income inequality). The gap between the two lines began to grow in the early 1980s as income inequality began to rise. Adjusted personal consumption is lower in most years except for a few years in the 1960s when income inequality was lower. The adjustment for income inequality is the biggest adjustment reducing well-being in the GPI accounting framework.

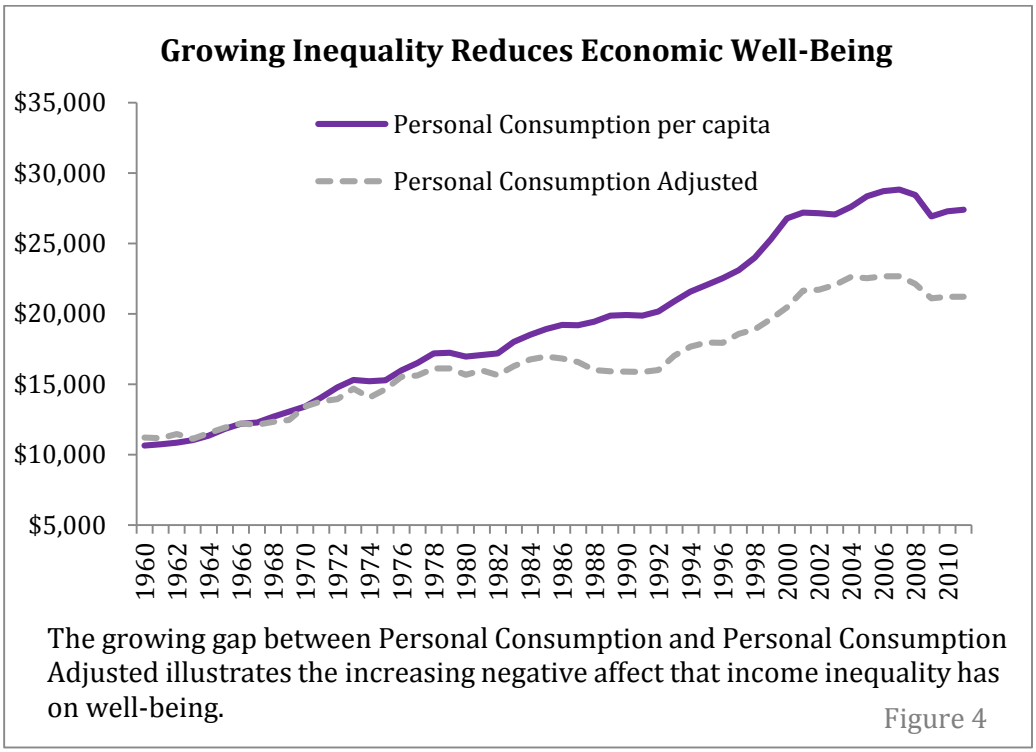
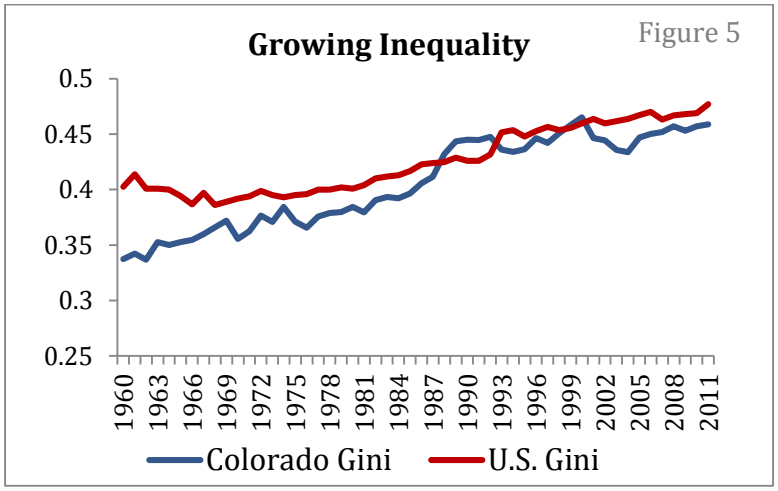


Figure 5 shows that the income distribution index in Colorado is now at its most unequal level since 1960. For example, the U.S. Census Bureau reported in 2011 the lowest-income 20 percent of population received only 3.4 percent of Colorado personal income while the top 20 percent received 49.1 percent (U.S. Census, 2011). The 1960s saw the lowest level of income inequality in the state; since then, the trend has been upward toward more inequality. Income inequality in Colorado grew the fastest during the 1980s. The early 1990s had a period of declining income inequality due mainly to rising real wages, periods of low unemployment and rising minimum wages.



Recessions tend to exacerbate income inequality. During the past three business cycles before the Great Recession in 2008, the highest-income groups saw their wealth rise substantially while the middle and low-income groups saw very modest growth. The Great Recession harmed households at all income levels including the wealthiest, but the richest households have bounced back while the low-income groups continue to stagnate.

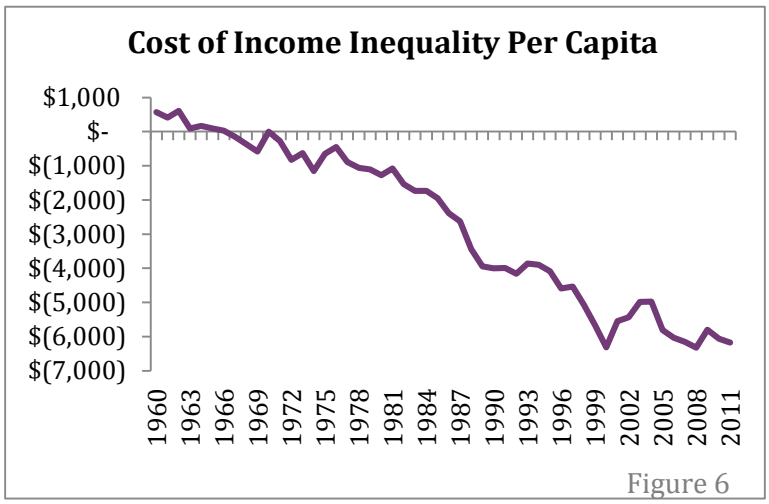


Figure 6

In 2011, Colorado ranked 24th among states in levels of income inequality according to U.S. Census 2012 three-year estimates of state Gini coefficients. The average income of the wealthiest 20 percent of Coloradans is more than 8.2 times greater than the income of the poorest 20 percent of Colorado households.

Although Colorado ranks close to the national average in 2011 in income distribution, Colorado has had an above-average level of inequality growth compared to other states. From the late 1970s to early 2000s, Colorado had the eighth-highest level of growth of income inequality among the states (CBPP, 2013).

The cost of income inequality is the biggest detractor in Colorado's GPI model.

Services and Costs of Consumer Durables

Personal consumption expenditures, the starting point of the GPI, includes spending on things like cars, mattresses, washing machines and refrigerators, also known as consumer durables. These items are expected to last for a number of years and the benefits of these items continue to accrue for the lifetime of the product.

Under the standard GDP framework, however, spending on durables is only counted in the year of the purchase. In order to account for the life of the durable, GPI captures the annual value of the services provided by them, instead of only looking at their purchase price. The GPI does so with a two-step calculation: by calculating the value of the stock of consumer durables, which is subtracted from GPI, and the value of their annual services, which is added to GPI. In other words, the GPI treats the services provided by consumer durables as the benefit and the initial purchase price as the cost. This allows GPI to take into account how long the items last.

GPI vs. GDP (Consumer Durables)

Consider the purchase of a car that breaks down or needs to be replaced every year. Both repairs and purchases of cars increase GDP. So from a GDP framework, replacing a car every year is a good thing, but it leaves the household no better off. The GPI accounts for the benefits that the car provides each year to get a more accurate depiction of the welfare generated from durables.

The costs of consumer durables are calculated from national estimates of the cost of consumer durables and are scaled-down for Colorado based on the ratio of state personal income to the national total. Economic theory defines the annual services derived from durables as the sum of the depreciation rate and interest rate (Talberth, 2007). The interest rate is included under the assumption that the purchaser of the durable could have received that much interest from investing that money used to purchase the durable. Based on the assumption that durables last on average eight years, which translates into a 12.5 percent depreciation rate and a 7.5 percent interest rate, the annual value of services from durables is estimated as 20 percent of the total stock of durables in Colorado.

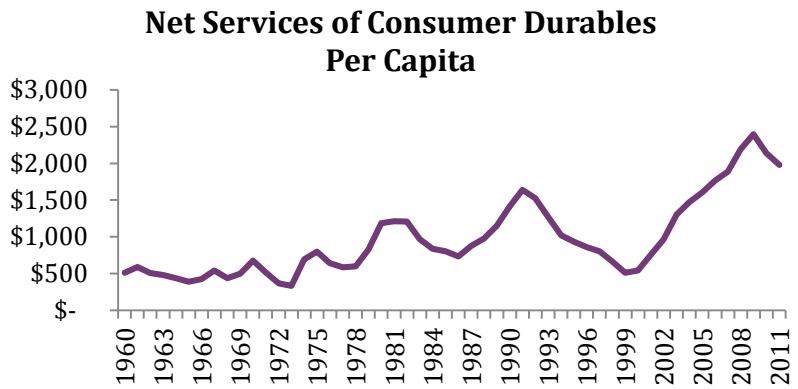


Figure 7

The percentage of our income we spend on household durables has remained fairly consistent over the past 50 years, averaging between 10 percent and 11 percent. However, these expenditures generally fluctuate over the course of the business cycle. For example, the percentage of income spent on durables fell to 8.4 percent during the Great Recession in 2008 and 2009.

In 2011, the benefits from household durables amounted to $25.1 billion and their costs were $15 billion. So consumer durables added a net benefit of $10.1 billion to Colorado well-being in 2011. Net Services of Consumer Durables is the third largest addition to Colorado's GPI model.

Cost of Underemployment

To reach the state's full economic potential, Colorado must be able to utilize its human and economic capital to the fullest extent possible. When all workers are not able to work as much as they desire, full economic potential is not achieved. GPI considers labor underutilization as an undesirable consequence of the market economy, the costs of which are deducted from well-being so GPI doesn't overstate the benefits created by our economic activity.

The costs of underemployment include both economic and social. The direct economic costs of underemployment are the declines in economic output because the workforce isn't fully being used. Beyond the declines in economic output, however, underemployment also creates individual and social costs. Declines in mental health and the decay of skills and motivation are all associated with workers who are not able to work as much as they desire. Persistent joblessness can also deteriorate social values and cohesion in the community (Sen, 1997). Some of these social costs are captured in other components of the GPI, like in

the divorce indicator or crime indicator, but because not all of the social costs of underemployment are accounted for, GPI subtracts the cost of underemployment from economic well-being. GPI does so by treating each hour of underemployment as a cost. (Even though GPI places value on free time, which is captured in the lost leisure indicator, it recognizes that forced free time, i.e., hours that the individual would rather spend working but cannot, are a social burden.)

Underemployment is a broader category than unemployment. It refers to persons who are chronically unemployed, who have given up on looking for work, who would prefer to work full-time but are unable or who are constrained by barriers like child care or transportation.

Why does GPI make a distinction between unemployment and underemployment? The financial difficulty of unemployment is, to a small extent, mitigated by unemployment insurance payments which are already counted in the personal consumption component of GPI. The underemployed population does not get such compensation. GPI places a value on underemployment by adding up all the unprovided hours of each constrained worker then multiplying those hours by an average wage rate.

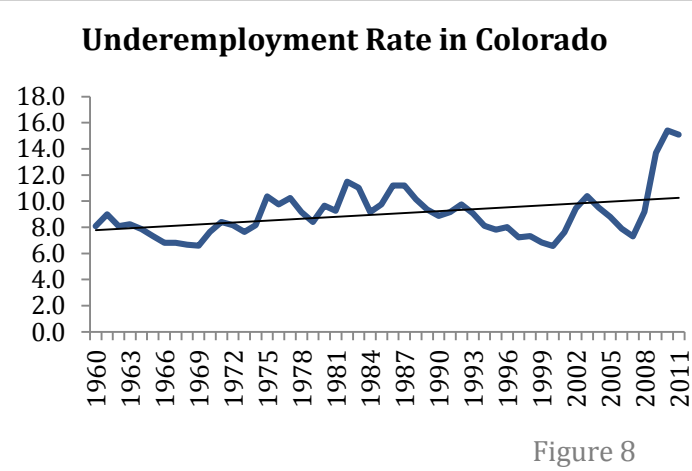


Figure 8

The cost of underemployment has exhibited a slight upward trend since 1960. Downturns in the overall economy are the biggest driver of underemployment. The number of underemployed workers in Colorado was particularly impacted by the last two recessions as the spikes in 2001 and 2008 show in Figure 8. Downturns in the economy, however, are not the only driver of underemployment. The upward trend in the cost of underemployment indicates that more and more workers in Colorado cannot achieve their desired amount of work.

In other words, there is a persistent level of underemployment in Colorado now that goes beyond the cyclical unemployment that accompanies recessions. And this level of underemployment has been slowly rising since 1960.

In 2011, there were more than 411,000 underemployed Coloradans each working on average 17 hours less per week than desired. Unemployment accounted for the fourth largest deduction in the Colorado GPI model.

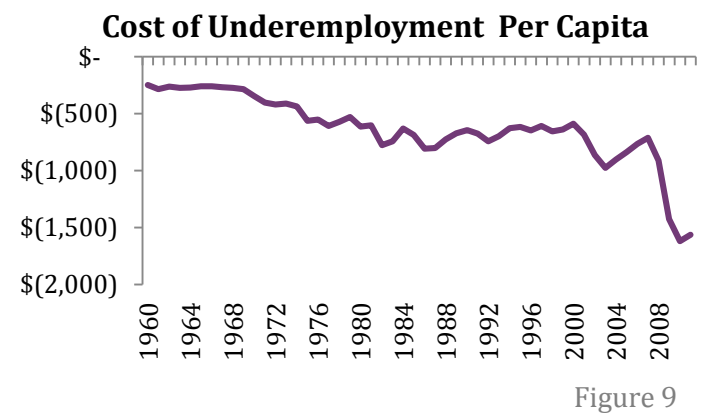


Figure 9

Net Capital Investment

In order to continue to prosper over time, an economy must maintain or increase its supply of capital (e.g., machinery, buildings and infrastructure) to meet the needs of an increasing population. If this doesn't happen, the society is consuming its capital as current income. Similarly, if the state invests more than the level needed to maintain its current stock of capital per worker, this investment will provide for higher consumption later. Hence, one element of GPI measures capital available for each worker.

GDP vs. GPI (Net Capital Investment)

If Coloradans suddenly decided to spend all the money that they were going to use to maintain the stock of capital equipment to keep a stable labor-to-capital ratio, and instead spent it on ice cream, it would make no difference to GDP because all the money is still spent on goods. But GPI would suffer since it depletes future sustainability. GPI counts this depletion in the year it occurs.

GPI calculates changes in the stock of capital by adding the amount of new capital stock and subtracting the amount necessary to maintain the same level of capital per worker.

If the labor force grows faster than the growth in capital stock, then the amount of equipment available per worker will fall and GPI will capture this negative effect on well-being.

Likewise, if capital stock outpaces the growth in the labor force, workers will have more equipment to help boost consumption in the future and GPI will capture this positive effect.

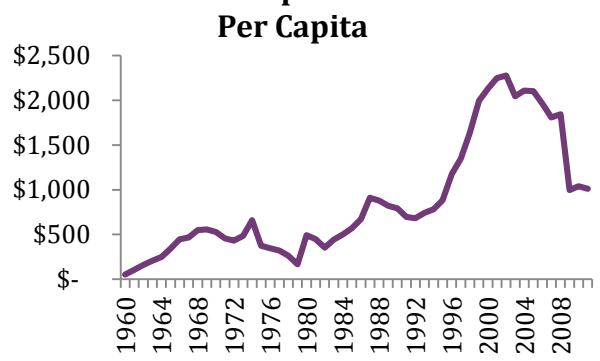


Figure 10

CHAPTER 4: ENVIRONMENTAL COMPONENTS OF THE GPI

Cost of Water Pollution

Clean water in Colorado's rivers, streams and lakes provide many services, from user benefits like drinking water, fishing, boating, rafting and swimming to non-user benefits like providing aesthetics and increasing property values. Destroyed, polluted, or impaired waterways result in lost tourism, lost recreation, lost fisheries and reduced aesthetics.

The GPI places a value on water pollution by first estimating the total benefit of perfectly clean water in Colorado based on Freeman (1982) then uses this value to calculate the cost of water pollution based off the percentage of those waterways that are impaired. Following the methodology of Maryland's state GPI study, a per capita value of clean water of $130 was used for the Colorado GPI.

TABLE 6. THE COST OF WATER POLLUTION IN COLORADO

	1960	1970	1980	1990	2000	2010
Population	1,769,000	2,223,979	2,908,803	3,307,618	4,326,921	5,047,692
Per capita value of clean water	$130	$130	$130	$130	$130	$130
Total value of clean water	$230 million	$289 million	$378 million	$430 million	$563 million	$656 million
Percent of streams, rivers and lakes impaired	13.3%	17.9%	19.5%	19.5%	16.3%	13.3%
Cost of water pollution	$30.6 million	$51.7 million	$73.9 million	$84 million	$91.7 million	$87.4 million

This was applied to population for every year to calculate a total value of clean water. Finally, to get the cost of water pollution, the percentage of impaired streams, rivers and lakes was multiplied by the total value of clean water.

The cost of water pollution in Colorado is a relatively small deduction from Colorado's GPI: costing the state $87 million in 2011.

Cost of Air Pollution

The GPI subtracts the negative costs to society of air pollution. Most of the damage associated with air pollution comes from premature mortalities. Overall reductions in human health account for 94 percent of the total damages of air pollution as poor air quality is linked to respiratory problems, asthma and increases in hearth attacks (Muller and Mendelsohn, 2007). The remaining 6 percent come from visibility loss, reduced agricultural

yield, reduced timber yield, accelerated depreciation of man-made material and impaired forest health.

Five pollutants were included in the analysis. Two were "particulate matter," also known as particle pollution: large particulate matter (PM10) and fine particulate matter (PM2.5), which is a mixture of small particles and liquid droplets. The EPA is concerned with particles less than 10 micrometers in diameter because those particles can easily enter the lungs through the nose and throat.

The third pollutant was Nitrogen Oxides (NOx) which are commonly caused by vehicle emissions. The fourth was Sulfur Oxides (SOx), which are mainly generated from industrial processes, and fifth was Volatile Organic Compounds (VOCs), which are emitted gases from a wide range of products from paints to glues to markers.

The Environmental Protection Agency's National Emissions Inventory Database has been tracking state level pollution emissions since 1990 and national level emissions since 1975. For prior year figures, Aneilski and Rowe's (1999) assumptions were used: air quality declined 2.4 percent per year in the 1960s.

GPI estimates the cost of pollution by multiplying the emissions estimates for each of the five pollutants by the per-ton cost for each reported by Muller and Mendelsohn (2007). The per ton damages in Colorado in 2000 dollars of large particulate matter is $544 per ton, fine particulate matter damages were $3,462 per ton. The per ton damages of Nitrogen Oxides were $273 per ton. Sulfur Oxide damages were $1,261 per ton and those from Volatile Organic Compounds were $676 per ton.

The cost of air pollution has been slowly falling since the early 1970s, which can in part be explained by the Clean Air Act of 1970. Nationwide, emissions of the six most common pollutants have fallen 72 percent since 1970 while the population has grown by 53 percent and vehicle miles traveled have increased by 165 percent (EPA). The cost per capita of air pollution has fallen dramatically from its peak in 1966 of $687 to $200 per capita in 2011.

In 2011, total air pollution cost Colorado $1.02 billion. Accounting for nearly half (48 percent) of all air pollution costs were wildfires and agricultural/construction. Wildfires and dust are so costly because they are the biggest producers of fine particulate matter, whose cost per ton in damages is the highest of the five pollutants. Petroleum and related industries contribute $161 million in damages or about 16 percent of the total air pollution costs. Emissions from

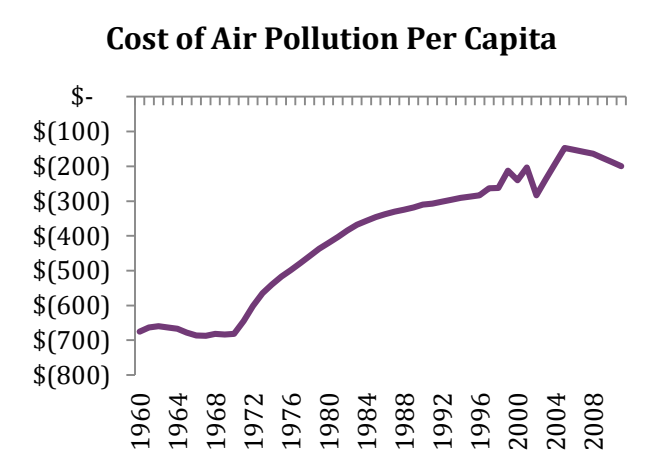


Figure 11

automobiles cost Colorado $70 million and accounted for 7 percent of the total pollution cost. Automobiles account for a third of all nitrogen oxide emissions in the state.

Due to the state's climate and topography, pollution emissions disporportionately impact Coloradans because of a condition called "temperature inversion," which occurs when warm air traps cold air near Colorado's land surface. This condition affects large mountain valleys the most (Doesken, 2007). When temperature inversions occur, a regularity in the winter, air pollution can't escape into the atmosphere. The warm layer of air acts as a cap, trapping pollution near ground level.

Cost of Noise Pollution

The GPI subtracts the costs of noise pollution. Noise pollution disrupts recreation, sleep and general welfare. Not only can noise disrupt our environment at work and at home, it also has negative effects on health.

State-level noise pollution figures are not available. To get an estimate for Colorado, national noise pollution data was scaled down to the state level, based not simply on population but on Colorado's urban population, since the majority of noise pollution occurs in cities.

TABLE 7: COLORADANS LIVING IN CITIES

	1960	1970	1980	1990	2000	2010
Colorado population	1,769,000	2,223,979	2,908,803	3,307,618	4,326,921	5,047,692
Colorado urban population	1,292,790	1,733,311	2,329,869	2,715,517	3,633,000	4,332,761
Percent living in Colorado cities	73%	78%	80%	82%	84%	86%
Percent living in U.S. cities	70%	73.6%	73.7%	75%	79%	81%

Source: U.S. Census Bureau

Colorado is an above-average urbanized state. Eighty-six percent of Coloradans live in cities compared to 81 percent of people nationwide. Colorado ranks 14th highest in urban population among states. California ranks the highest, with 95 percent living in cities, while Maine has the lowest percentage of its citizens living in cities at 39 percent, according to the 2010 U.S. Census.

The value of damage caused by noise pollution comes from a World Health Organization study that estimated damages for the nation in 1972 at $4 billion (Congressional Quarterly Inc., 1972).

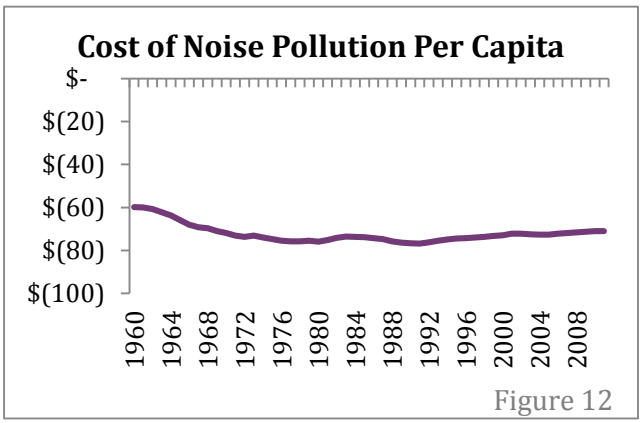


Figure 12

This estimate used by Talberth (2007) amounts to $14.6 billion in 2000 dollars.

The average cost of noise pollution per person living in an urban area was $83 in 2011. In Colorado, the total cost of noise pollution has steadily increased due to the state's increased urbanization. In 2011, noise pollution cost Colorado $363 million, a very moderate reduction in well-being.

Cost of Wetlands Change

Wetlands provide a number of ecosystem services, such as aid in nutrient cycling, help regulate floodwater disturbances, purify water and provide habitat for water creatures and birds. More specifically, wetlands filter bacteria, viruses, nutrients, and other harmful things from water through biochemical reactions (Berik and Gaddis, 2011). Wetlands also provide flood control by acting like a sponge that is able to suck up floodwaters and help reduce the destruction of flooding on man-made structures (MEA, 2005). In particularly dry areas across Colorado, wetlands help suppress dust.

Since wetlands, like forests and farmland provide value to an economy, the loss of wetlands is a loss in economic value that can be measured.

The cost of wetlands loss is calculated by multiplying the acreage of lost wetlands by the value per acre. The tricky part to calculating lost acreage of anything is to first decide what is the original baseline year and thus the baseline acreage from which to calculate losses. We chose 1960 as the base year. Thus, each year's lost wetland acreage is calculated as the difference from the acreage in 1960.

The value per acre of wetlands used in this GPI study is $22,452 following Utah's GPI study which uses Dodd et al., (2008). Since wetlands are relatively rare in the arid Colorado climate, an acre of wetlands in the state is likely more valuable than an acre of wetlands in a coastal state. Thus, the value per acre is much higher than similar land in Maryland's GPI study.

Colorado has gained approximately 120,000 acres of wetlands since the low point in 1992, according to the National Land Cover Database, although this figure should be qualified since wetland acres are particularly difficult to measure. Because of this, the cost of lost wetlands fell from $6 billion in 1992 to $3.2 billion in 2011.

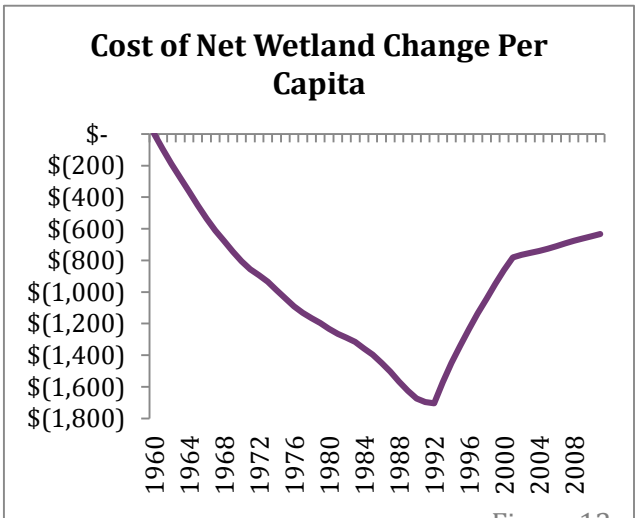


Figure 13

Cost of Net Farmland Change

The GPI measures the loss of both natural and human-built capital because they generate costs to both present and future generations in the form of lost benefits from that capital (Talberth, 2007). Lost farmland represents losses in sustainable food supplies for the future. Farmland also provides indirect services in the form of flood prevention, scenery and wildlife habitats.

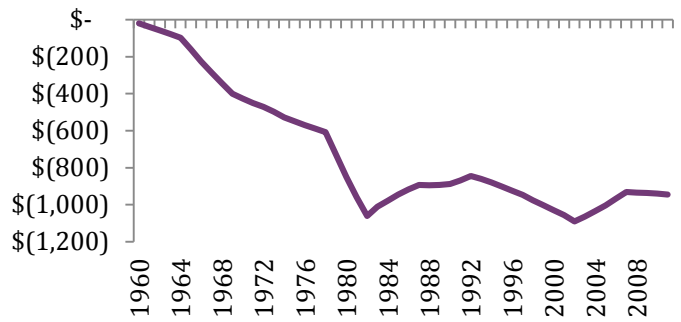


Figure 14

In calculating GPI, we address farmland losses. The cumulative value for lost farmland is calcuated by multiplying each year's value per acre by the acres lost in that year and adding it to the previous year's loss following Talberth (2007).

The USDA's Census of Agriculture provides the number of acres of farmland in Colorado as well as a value per acre. In 2011, an acre of farmland was valued at $869.

Colorado has lost 20 percent of its farmland acreage since 1960. There were 31.1 million acres in 2011 down from 38.7 million acres of farmland in 1960. Losses of farmland acreage are compared to the baseline year of 1960. The cost of a lost acre of farmland is cumulative, which means the cost is the lost productive capacity each and every subsequent year of its loss. In 2011, the cumulative cost of lost farmland totaled $4.8 billion.

TABLE 8: COST OF LOST FARMLAND IN COLORADO

	1960	1970	1980	1990	2000	2010
Total Farmland Acreage (millions)	38,682	36,538	34,504	34,009	31,710	31,296
Value per acre (2000 USD)	$328	$504	$806	$563	$705	$869
Cost of Lost Farmland (billions)	$0.03	$0.95	$2.47	$2.94	$4.45	$4.75

Cost of Net Forest Cover Change

In addition to the use of trees for timber, forests help control floods, purify water and air, provide areas for hunting, camping, and hiking, provide habitats for animals and provide scenery. The GPI accounts for the cost of lost forest cover by multiplying each lost acre by $318.50 following the methodology of the Maryland GPI study which draws from the literature on the economic valuations of forest carbon sequestration and non-timber related forest products (Pearce, 2001).

Colorado has lost 10 percent of its forest acreage since 1960. In 2011 Colorado had 20.3 million acres of forests which is down from 22.6 million in 1960. The GPI sets 1960 levels of forest land as the baseline and compares the loss in acreage each subsequent year off that baseline. In 2011, the cost of lost forest cover totals $735 million.

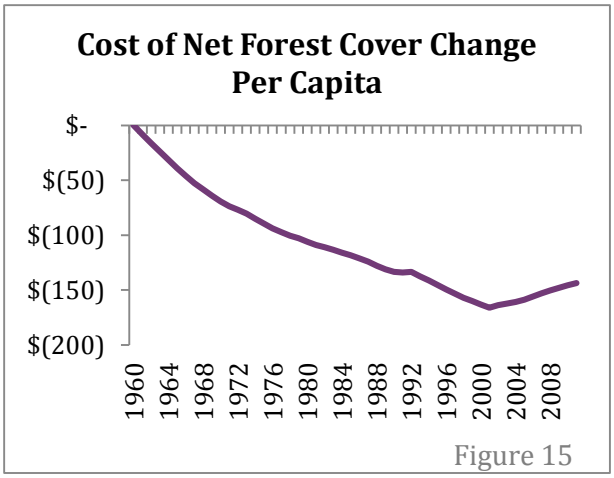


Figure 15

Cost of Environmental Impact

Concentrations of greenhouse gases, particularly carbon dioxide, are generally thought of as the cause of climate change. The effects and costs of climate change are a global issue as causes and side effects of climate change disproportionately spread across the globe.

The GPI quantifies the cost of climate change by looking at carbon dioxide emissions from the consumption of different forms of energy and multiplying those by a cost per ton. This method estimates the value of damages that Colorado's emissions will cause, even though those damages might occur elsewhere. (In contrast, a "damages suffered" approach would estimate costs based on the impact to the state's assets.)

Colorado is impacted by climate change directly through water scarcity. Lower water levels and snowpack directly influence the likelihood of wildfires. It directly affects farmers' ability to feed and water their livestock and crops and for Colorado to deliver legally mandated levels of water to downstream states within the Colorado, Platte, Arkansas and Rio Grande river basins. Finally, reduced snowpack has a direct effect on the Colorado ski industry. A high snowfall year generates $154 million more in direct spending than a low snowfall year, plus $116.6 million more in economic multiplier effects (Burakowski and Magnusson, 2012).

The cost per ton of carbon dioxide emissions used in this study is $24.43 in 2004 from Tol (2005), in which the authors conducted a meta-analysis of 103 other climate change costs studies. Following Talberth (2007), we assumed carbon dioxide emitted before 1964 caused no damage since 1964 was the year when carbon emissions began exceeding natural carbon

sequestration capacity. The cost per ton of carbon dioxide emissions used in this study is greater than the $89.57 value used by Talberth since the study misinterpreted Tol's "cost per ton of carbon" for the "cost per ton of carbon dioxide" (Hawaii State Environmental Council, 2013). The cost per ton of carbon dioxide was zero in 1964 and $24.43 in 2004. A linear trend was used to calculate carbon dioxide costs for each year between 1964 and 2004.

The total cost of environmental impact has steadily increased for two reasons. First, Colorado's consumption of carbon dioxide emitting sources has increased. Second, the cost per ton of carbon dioxide emissions has grown from $0.61 in 1965 to $28.71 in 2011. In 2011, the cost of environmental impact cost Colorado $2.8 billion.

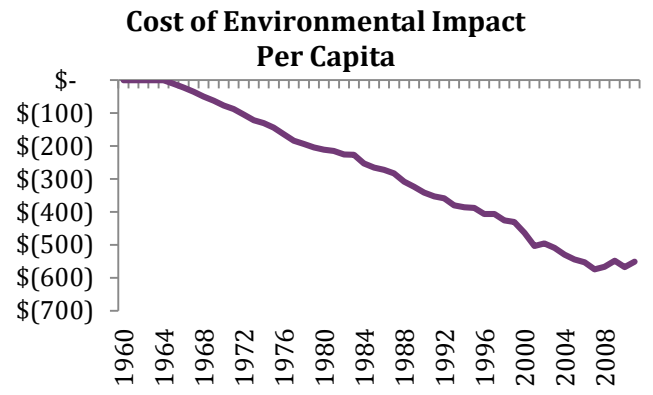


Figure 16

Cost of Ozone Depletion

Very little data exists about emissions of chlorofluorocarbons (CFCs) in Colorado and even if state data was available, it is hard to say where actual emissions take place. Following Costanza et al. (2004) and Bagstad and Ceroni (2007), we estimated the cost of ozone depletion for Colorado from the national level, which is calculated as one-third of the world production of CFCs. National numbers were calculated using data from the Alternative Fluorocarbons Environmental Acceptability Study (AFEAS), the U.S. Environmental Protection Agency, the United Nations Environmental Program and the U.S. Congress and by multiplying cumulative emissions by $49,669, the same value used in Talberth (2007). We take the national cost of ozone depletion and scale it down to Colorado based on population, which assumes that per-capita ozone depletion costs are the same across states.

The release of ozone-depleting chemicals has fallen dramatically since the Montreal Protocol in 1989 (AFEAS 2006). The release of CFCs are at a fraction of what they were at their peak in 1988. Still there are ozone-depleting chemicals in the atmosphere that continue to contribute to health effects from ultraviolet light exposure. Colorado hit its peak ozone cost in 1974 at $242 million. That cost has dramatically fallen to $0.16 million in 2011.

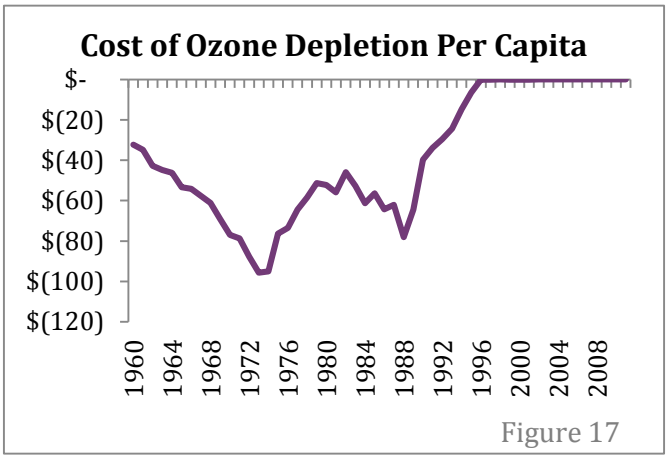


Figure 17

Cost of Non-Renewable Energy Resource Depletion

The GPI includes the depletion of natural capital as a cost to well-being in order to assess the sustainability income levels in the future. The depletion of non-renewable resources like coal, natural gas, and petroleum causes a net loss of wealth to Colorado since they are sources of income that cannot be sustained.

To measure sustainability of income and consumption in the future, the GPI values the accumulation and deducts the depletion of natural capital. The depletion of non-renewable resources creates a loss of wealth since that source of income cannot be counted on in the future. The GPI places a monetary value on the cost of resource depletion by the cost it would take to replace those resources with renewable energy resources. This allows the actual cost of establishing new sources of energy to be attributed to the year in which that depletion actually occurs.

Consumption of non-renewable resources continues to climb. In Colorado, on a per capita basis, total non-renewable energy consumption has increased 9 percent from 1960 to 2011.

The Energy Information Association provides state-level figures on consumption of coal, natural gas and petroleum. The amount of coal, natural gas and petroleum was broken into two sector categories: electric sector and amount used outside of electric sector. This allows us to pin-point how much fuel can be replaced by solar and wind (for electric sector) and how much can be replaced by biofuel (non-electric sector). Electricity that is consumed and that can be replaced by solar and wind power is multiplied by 8.75 cents per kilowatt hour following Costanza et al., (2004); Bagstad and Ceroni (2007); and Venetoulis and Cobb (2004), who utilize cost estimates from Makhijani (2007). Energy that is consumed that cannot be replaced by solar and wind, and which must be replaced by other biofuels, is multiplied by $116 per barrel.

The growth in electricity consumption in Colorado has greatly outpaced the amount of electricity produced by renewable sources. Since 1960 total electricity consumed in Colorado has grown by a factor of 10 (increased 1000 percent). Over the same period, electricity from hydroelectric energy sources has only increased by a factor of 1.15 (increased 115 percent). This explains the steady rise in replacement costs in the electrical sector.

The total per-capita cost of non-renewable resource depletion has not changed much since 1960. In 1960, the per-capita total cost was $4,272, and in 2011, it stands at $4,337. The cost of non-renewable resource depletion is the second largest deduction from the Colorado GPI.

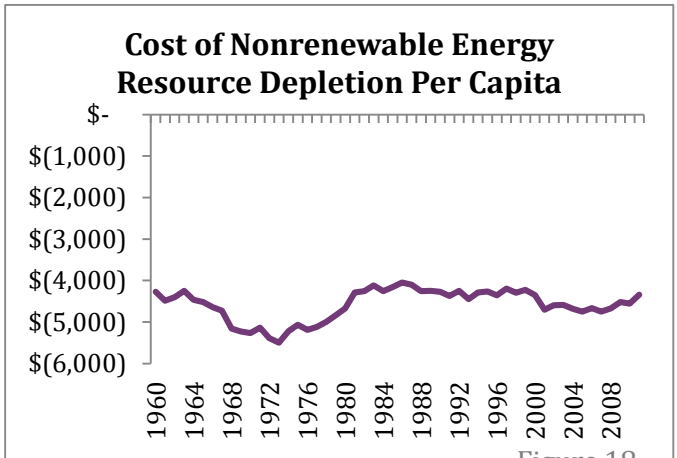


Figure 18

Chapter 5: Social Components of the GPI

Value of Household Work

Parenting, household chores, eldercare and house maintenance are all important factors that contribute to Coloradans' well-being, yet they are almost entirely omitted in the standard GDP framework. GDP does not count the value of a parent staying at home to watch children, but paying for childcare is part of the "service sector" and adds to GDP. Recent evidence from the American Time Use Survey shows that parents find caring for their children to be much more exhausting than the work they do for pay, but that those parents also find much more meaning in the time they spend with their children than at work (Wang, 2013).

The GPI values the unpaid household work hours at the cost they could be provided if you paid someone to do them and thus would be included in GDP. So all the hours spent doing household work are multiplied by the hourly wage rate of what housekeepers earn in Colorado. The average housekeeper's wage in Colorado was $10.31 in 2011.

Hours spent doing household labor have significantly declined since 1960, falling from 1,698 hours a year per person to 832 in 2011. This means more household work is exported to the market sector and already counted in GDP. This distorts GDP upward compared to earlier years, when more household work was done outside the market for no pay.

Overall, the value of household labor contributed $27 billion to Colorado's GPI in 2011, making it the biggest positive component of GPI. However, the value of housework has declined from its 1986 peak.

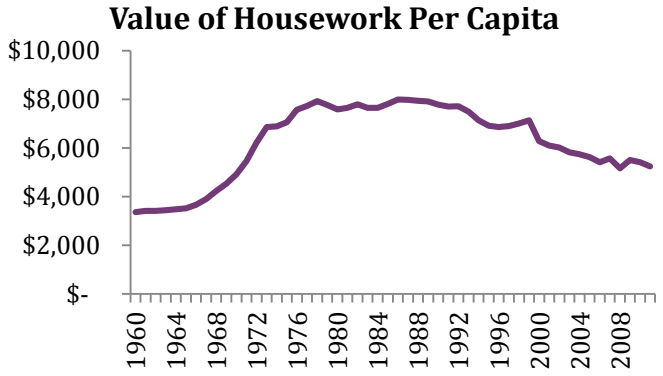


Figure 19

Cost of Family Changes

Arguably the most important asset and "service" in America is the family (Anielski and Rowe, 1999). Yet none of the value of families is counted in economic terms, while at the same time, more and more functions of the traditional family are being displaced by the market economy such as hired babysitters, the "television babysitter," shopping malls and take-out food (all of which are counted in GDP). So, more and more household services are being exported to the market economy. GDP treats

GDP vs. GPI (Cost of Family Changes)

In the GDP framework, divorce is counted as a positive in the form of spending to set up separate households, and to pay lawyers' and counseling fees. The GPI methodology, however, treats divorces and family separations as having costs, because they reduce the well-being of the individuals and children involved.

this transfer and erosion of family life as an economic benefit, since the functions of the family, which are not monetized, are shifted to the market and more money is exchanged (Anielski and Rowe, 1999).

Two proxies have been used to measure the cost of family breakdown in national GPI studies: the cost of divorce on adults and children involved and the cost of television watching in families with children.

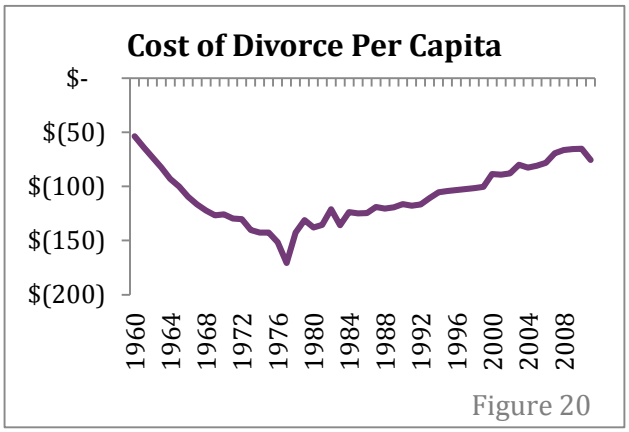


Figure 20

The total cost of divorce includes the direct costs on the adults and the indirect costs on the children affected by divorce. The direct cost to adults per divorce was $8,999 following Anielski and Rowe (1999), which was based on expenses for legal fees, separate residences and counseling. The cost of divorce to children was taken from the same study: $13,380 per child affected by divorce, which was a monetized approximation of lifetime damage incurred, difficulties at school, work and troubles in personal relationships.

While the total number of annual divorces in Colorado continues to rise, the number of children affected each year by divorce has fallen from its 1977 peak. This is due to the fact that the average number of children in a household where divorce occurs has fallen from 1.34 in 1966 to 0.61 in 2011.

The total costs of divorce in Colorado reduced well-being by $386 million in 2011.

The second type of family breakdown cost comes from television watching. Research has linked TV watching to obesity, diminished parent-child interactions and harmful effects on toddlers who watch adult television (Kirkorian et al., 2009). The GPI uses television viewing as a proxy to measure decreased time spent in personal family interactions.

Television viewing has continued to grow. Households in 1960 on average watched five hours of television daily. In 2011, the average household now watches 8.8 hours of television daily.

The cost of television viewing is estimated at $0.54 per hour following Costanza et al. (2004) and Bagstad and Ceroni (2007) which was adopted from Anielski and Rowe (1999). The GPI values the social cost of television watching by families by multiplying "hours spent per day per household of TV viewing" by "365 days per year" by "number of households with children." The social cost of

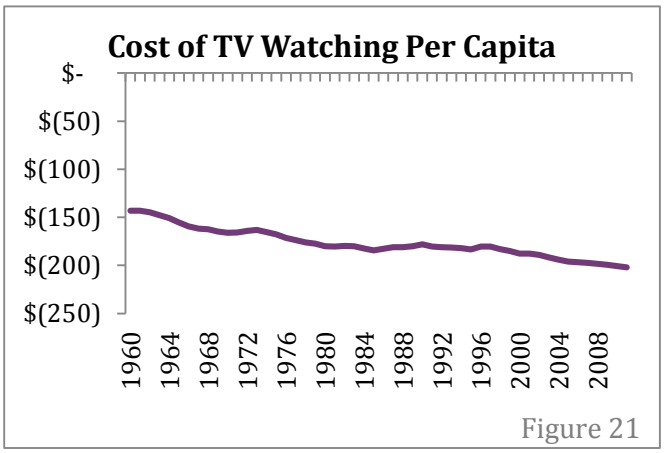


Figure 21

TV viewing was $1 billion for Colorado in 2011.

Overall, the cost of family breakdown, which includes cost of divorce and cost of television viewing, reduced Colorado's GPI by $1.4 billion in 2011.

Cost of Crime

The Colorado GPI calculates the cost of crimes following Maryland's example by capturing the damage inflicted on the well-being of crime victims from trauma and physical damages. This differs from other GPI studies that only captured the direct expenses from crime victims replacing damaged and stolen property and defensive spending to guard against crime like locks. This method ignores the damages inflicted on well-being through fear and trauma.

Costs of Crime used in the GPI

Murder: $2,276,281
Sexual Assault: $97,123
Robbery: $7,868
Aggravated Assault: $9,326
Breaking and Entering: $1,513
Larceny: $321
Vehicle theft: $4,290

To account for this, we used calculations from the Department of Justice on such costs. Crime cost estimates come from the National Institute of Justice adjusted into 2000 dollars. Both quality of life effects and property value are included in the cost of each crime.

The GPI values the cost of crime by multiplying each crime by the associated costs per crime, both quality of life effects and property losses, from research by the National Institute of Justice at the U.S. Department of Justice into Victim Costs and Consequences.

The cost of crime in Colorado rose markedly in the 1960s, peaking in 1981. Since 1981, the cost of crime has been cut in half, mirroring national trends. The total cost of crime for Colorado in 2011 was $717 million.

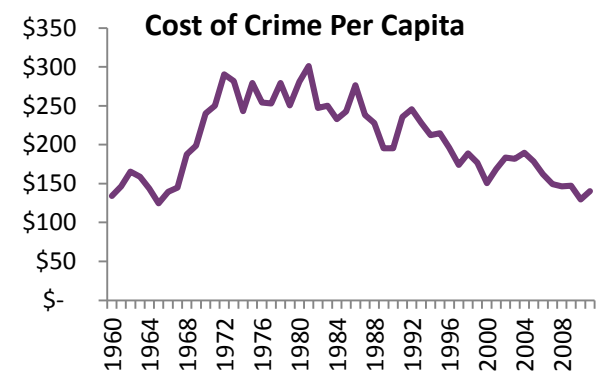


Figure 22

Cost of Personal Pollution Abatement

The GPI deducts defensive expenditures that do not improve the well-being of households but must be made to offset the harmful effects of our economic activity. Money spent to deal with pollution is a prime example of such defensive spending. Expenditures on air and water filters attempt to restore environmental quality back to the baseline level and should not be counted as dollars that add to our well-being. (Since government and business spending are not included in personal consumption expenditures, the GPI doesn't subtract their pollution abatement spending). Thus the money spent by individuals to prevent pollution is deducted from the GPI.

Households pay to reduce or dispose of their pollution in three methods: automobile emissions abatement, wastewater treatment and solid waste disposal.

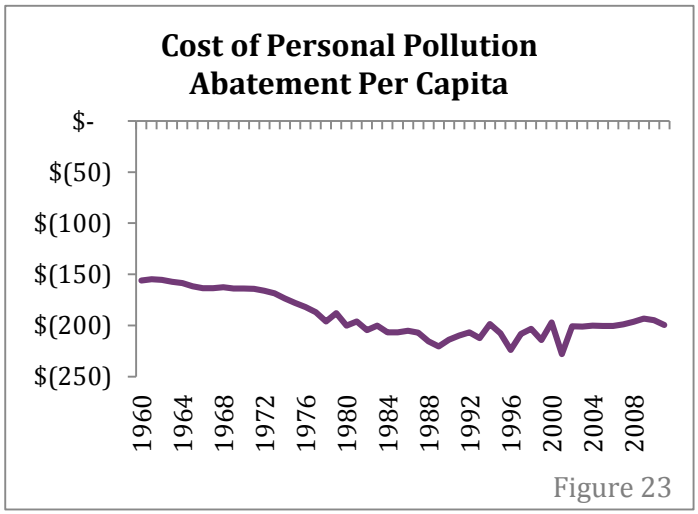


Figure 23

The cost of automobile emission abatement is calculated by summing up all the money spent on catalytic converters and air filters, which are part of new vehicle purchases and regular maintenance. Following Bagstad and Ceroni (2007), we value catalytic converters at $100 and air filters at $8.50.

The cost of wastewater treatment derives from the cost of septic systems (valued at $4,000) and sewer costs. We assumed the average household uses 250 gallons of sewer flow per day and sewer costs were $4 per thousand gallons of disposal. Finally, removal of solid waste was valued at $100 per ton.

Adding the total cost of what Coloradans spend on items to prevent pollution in the homes and in their cars delivers the total cost of personal pollution abatement. This cost was $1.02 billion in 2011.

Value of Volunteer Work

The work done by volunteers is another form of unpaid work that is not counted in GDP since no money changes hands. Volunteer work is a nation's informal safety net. It acts to augment services, filling the gaps in services that are provisioned by the market. (Utah GPI, 2011). Volunteer labor also helps create and strengthen social ties in the community.

The GPI calculates the value of volunteering by multiplying the total amount of volunteer hours performed by Coloradans by the average volunteer wage rate of $16.15 per hour.

Volunteers added $2.3 billion to Colorado's GPI in 2011. Overall 32.6 percent of Coloradans volunteered in 2011, a number which has grown since 1989 when the volunteer rate in Colorado was 23.5 percent.

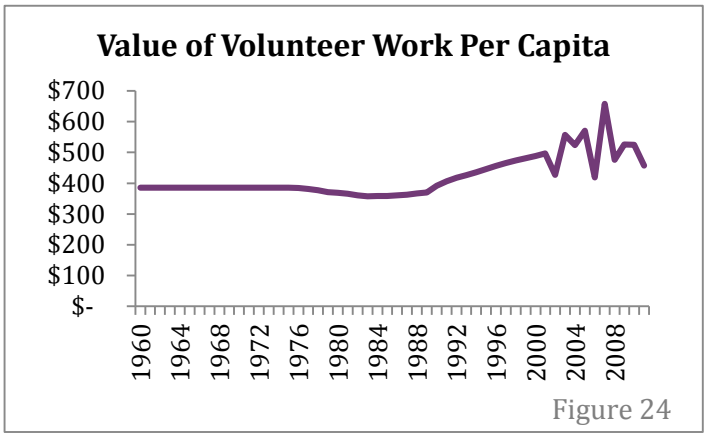


Figure 24

Cost of Lost Leisure Time

While GDP has given a false impression that workers are doing better, workers are working more hours and taking on more debt than they did in the past.

Because free time is not traded in the market the way labor time is, GDP completely disregards lost leisure time, thus GDP ignores the value of free time on our well-being. This is why the GPI accounts for leisure time lost or gained, so that we don't ignore the costs that we've been trading off for gains in salary. The commodity of time is being eroded, with subsequent costs for workers' health and stress levels and the cohesiveness of families and communities.

GDP vs. GPI (Lost Leisure Time)

If all Coloradans suddenly decided to work 80-hour work weeks, salaries would nearly double and GDP would spike, but this wouldn't tell us anything about higher levels of stress and lower levels of time spent with family and doing fun activities. The GPI corrects for this by subtracting lost leisure time.

The average full-time worker in Colorado works 245 more hours a year then they did in 1969, the year in which leisure time was at its highest (between 1960 and 2011). That's more than six weeks.

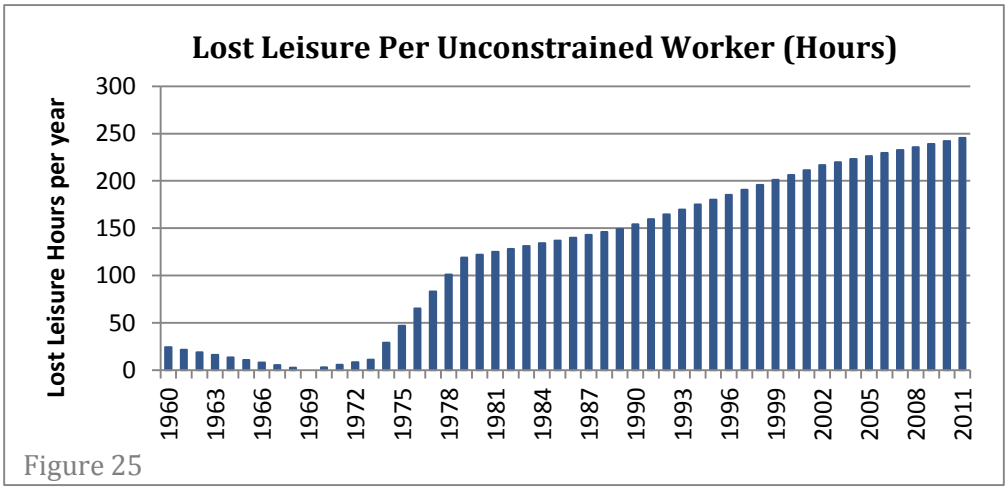


Figure 25

The GPI measures lost leisure time from a baseline year of 1969. The number of lost leisure hours per fully employed worker is multiplied by the average real wage per hour and then by the number of fully employed workers. The average wage was $21.28 (2000 dollars) in 2011.

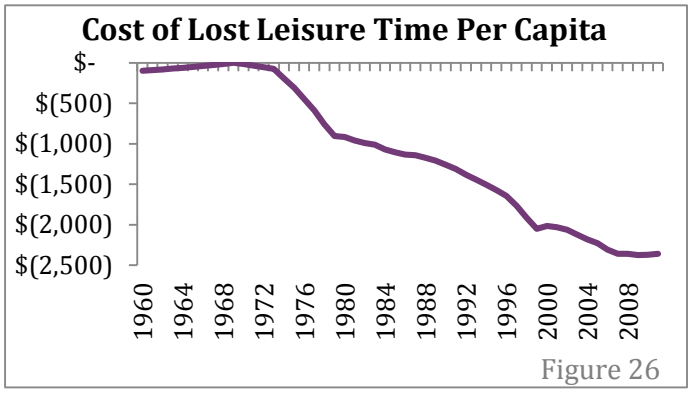


Figure 26

In 2011, lost leisure time cost Coloradans $12 billion, the third-largest deduction in GPI.

Value of Higher Education

The GPI community has had considerable debate about whether to include the value of higher education in the GPI model. Some studies consider it an investment and ignore it, while others have omitted it because it is part of consumption. Others omit it because they consider higher education merely a prerequisite to work and thus a defensive expenditure (Talberth, 2007).

While the earnings of college degree holders are higher than those without college degrees, this boost is already captured in personal consumption expenditures. However, there are other benefits of bachelor's degree holders: both individual and societal benefits of higher education go beyond the wage boost. McMahon (2010) quantifies the benefits in monetary terms of higher education. Among other factors, higher education is correlated to greater civic engagement, longer life expectancy, better child education and development and more optimal family size.

The value of a bachelor's degree used in our model is $10,500. Other studies use $16,000 from Hill et al. (2005). We feel that this double counts some of the benefits of higher education particularly the income effects of higher education that are already counted in personal consumption.

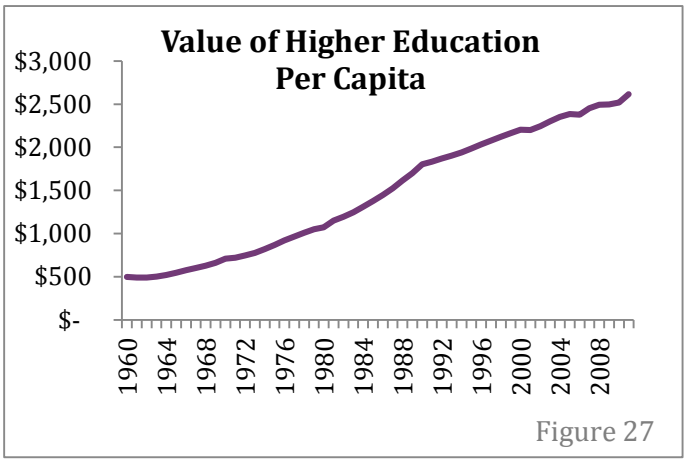


Figure 27

The value of higher education is calculated by the number of bachelor's degree holders multiplied by $10,500. Colorado is a very well-educated state, with 37 percent of the population age 25 and older holding at least a bachelor's degree. Colorado is the second highest educated state behind Massachusetts. In 2011, the value of higher education added $13.3 billion to Colorado's GPI. The growth in education attainment has been a positive contribution in the GPI as Colorado moved from 5 percent of the total population holding college degrees in 1960 to 25 percent of the total population holding college degrees in 2011.

Value of Highways and Streets

The GPI does not include most government expenditures since they are considered defensive in nature. In other words, they protect against erosions in the quality of life, rather than enhancing it (Leipert, 1989). This is particularly true of military spending, fire prevention and disaster relief.

Some government activities, however, offer services for a fee, like transit systems or public water and sewer. Since these fees are counted in personal consumption expenditures, there are other government services that could be sold in theory. The benefits of streets and highways are the biggest of such items. A large amount of government spending goes into providing built capital in the form of roads that provides benefits in future years. Sticking to the distinction between current income and capital investment, the stock of streets and highways cannot be added to GPI as income, but the benefits of the services the roads provide can (Utah GPI, 2011).

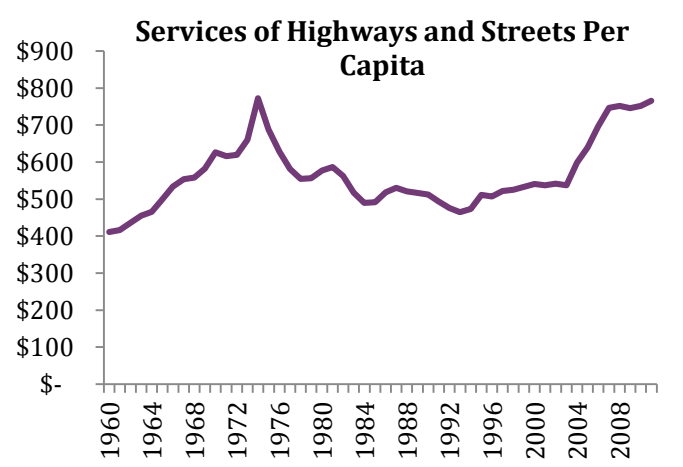


Figure 28

The value of services from highways and streets is derived from figures of net stock of federal, state and local government streets and highways from the Bureau of Economic Analysis. This is scaled down to Colorado based on the ratio of mileage in Colorado compared to the nation. The yearly value of services from streets and highways is estimated at 7.5 percent of the net stock value — based on the logic that around 10 percent of the net stock is the annual value (2.5 percent for depreciation and 7.5 percent for average interest rates). Because we assumed that 25 percent of all vehicle miles are for commuting, this leaves 75 percent as net benefits. Thus, the GPI assumes the net service value of streets and highways per year is 7.5 percent of net stock (10 percent of 75 percent).

Colorado has added more than 17,000 miles of highways since 1960, a 25 percent increase. The overall value of highways and streets in 2011 was $3.9 billion.

Cost of Commuting

Commuting to work is one of the undesirable but necessary side effects of our employment and residential patterns (Berik and Gaddis, 2011). It involves both direct and indirect costs. Buying, maintaining and using cars as well as money spent on public transit are direct costs. The time spent in traffic in order to get to work, also known as the opportunity cost, reflects a reduction in welfare since the time spent commuting could be spent freely with family, at leisure or working.

The GPI calculated the total cost of commuting through three components. Two are direct costs: public transit spending and the commuting cost of owner-operated vehicles. The third is an indirect cost: the opportunity cost or lost time of commuting.

The total cost is calculated by multiplying miles traveled to work by the cost per mile for vehicle users. This is added to the hours spent commuting multiplied by the average wage rate, which is added to spending on public transportation fares.

Each mile driven to work is multiplied by the mileage reimbursement rate of $0.44. The calculation does factor in the people who carpool, which is roughly 10 percent of workers. The total time spent commuting is multiplied by the average wage rate ($21.28 in 2011) to obtain the indirect costs of commuting.

GDP vs. GPI (Cost of Commuting)

If every individual decided to drive to work alone in an automobile, roads would be further congested which could cause the commute time and commute cost to increase for everyone. In GDP terms this would be a boost, but the GPI sees these purchases as "regrettable" and should be deducted from well-being. The more money that is spent on commuting to work, the more these "regrettable" purchases contribute to GDP.

There are an estimated 2 million cars driven to work in Colorado each work day. It took the average commuter 24.5 minutes to get to work in 2011. The average worker drives 15 miles each way to work. It takes Coloradans longer than the U.S. average to commute to work as Colorado ranks 31st among states in commute time. Workers in Maryland have the longest average commute, while workers in North Dakota have the shortest.

Commuting costs have risen steadily since 1960. Mileage driven to work has risen from 23.3 miles in 1960 to 30.3 miles. It takes an average Colorado worker six more minutes to get to work than it did in 1960, which doesn't sound like a lot, but when six minutes is added by both ways over a year of work, the total is more than a week of work at an additional 50 hours per year. The cost of commuting per capita has increased by 173 percent since 1960. Overall, the cost of commuting, as shown in Figure 29, deducted $7.1 billion from GPI in 2011.

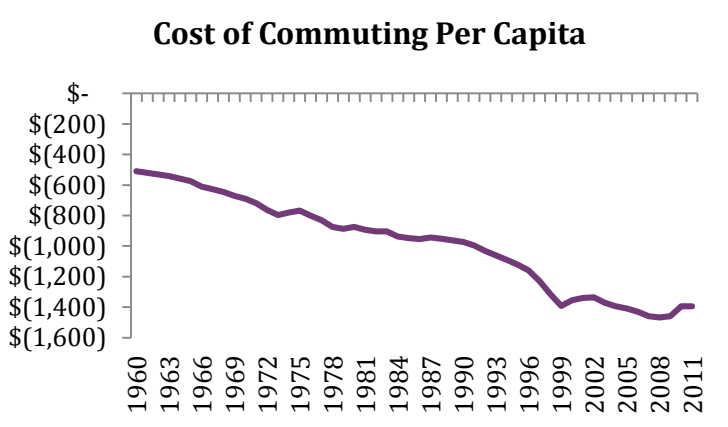


Figure 29

Cost of Motor Vehicle Crashes

The cost of motor vehicle collisions help represent the cost of increasing traffic densities and urbanization. The GPI deducts "regrettable" purchases since they do not add to well-being. The damage from car crashes is a prime example of such "regrettable" spending. The money spent to replace damaged property and healthcare expenses are the direct costs. There are also indirect costs which include the value of lost life and the lost wages associated with injury and death.

Average Costs, Car Accidents in Colorado	
Accident with death	$1,024,000
Accident with injury	$36,000
Accident property damage only	$6,400

The GPI calculates the cost of car crashes by multiplying each type of crash (fatality crashes, injury crashes and property damage-only crashes) by its respective average cost. Values per accident from the National Safety Council (NSC) Injury Facts 2004.

Overall, motor vehicle crashes in Colorado cost $1.35 billion in 2011. This is only up slightly from $1.16 billion in 1960, even though the number of vehicles driven has more than doubled over the same period. On a per capita basis, the cost of motor vehicle crashes are a third of what they were in 1972.

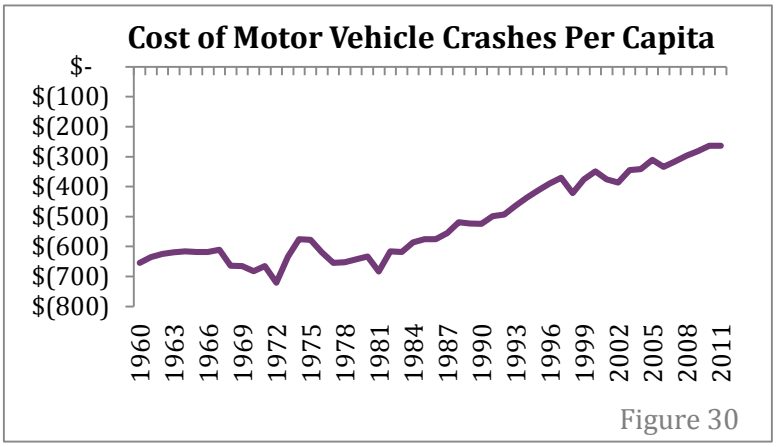


Figure 30

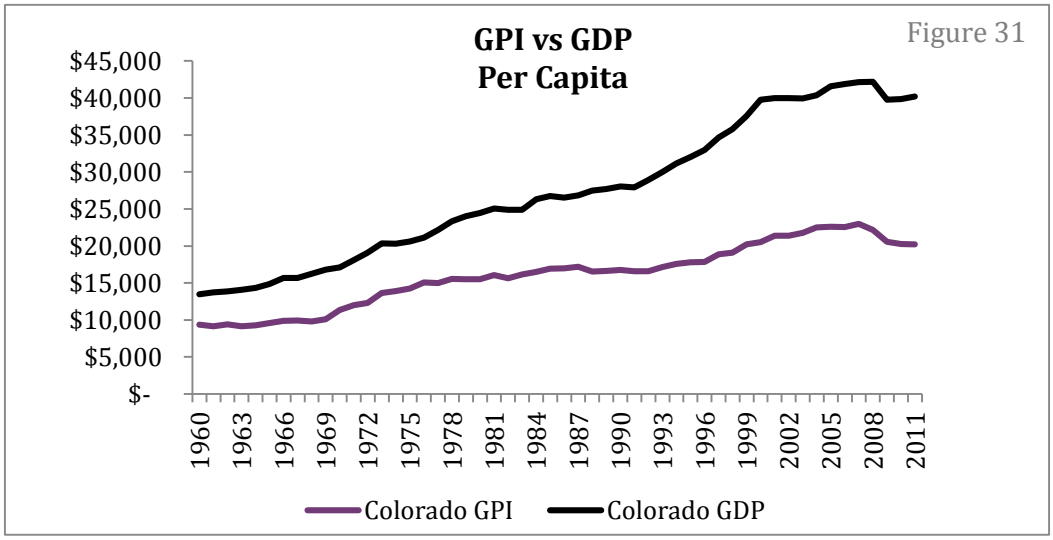
Colorado has less automobile crash fatalities than the U.S. average ranking 19th among states in rate of automobile crash fatalities per miles driven.

CHAPTER 6: COLORADO'S GPI TRAILS ITS GDP

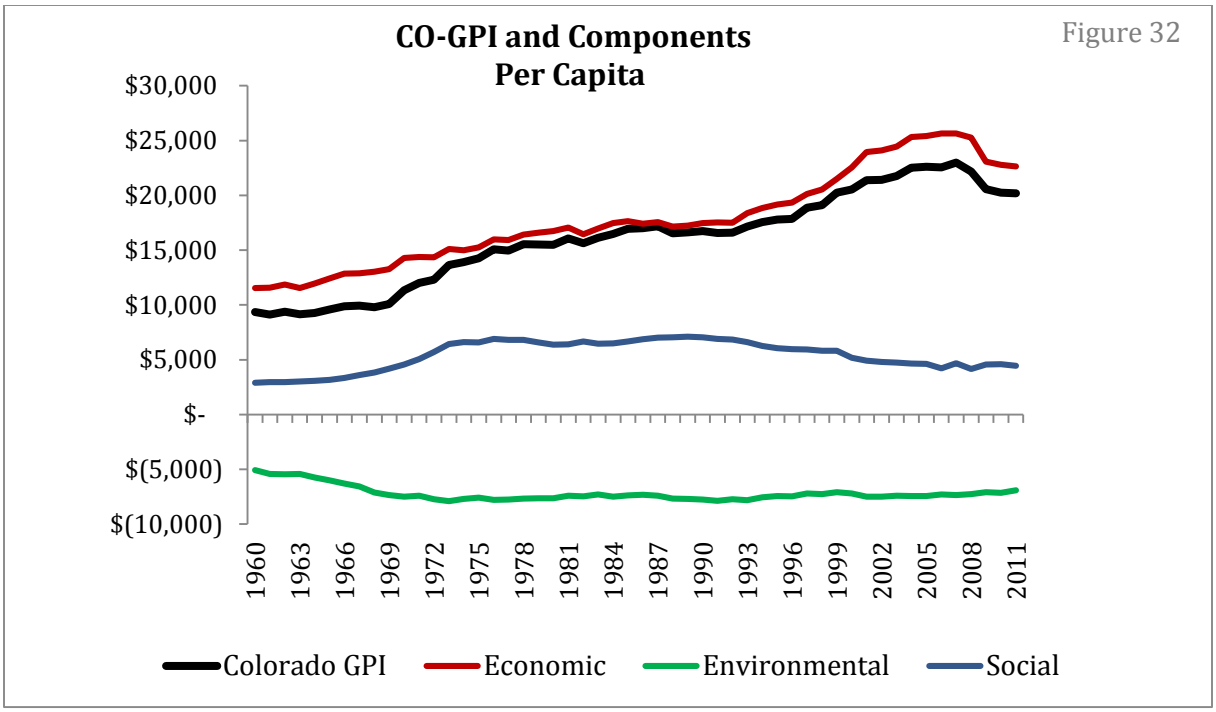
Colorado GPI increased between 1960 and 2011 suggesting that Colorado has made genuine progress, although at a slower pace than Colorado's GDP — suggesting that the GDP framework overstates the advancement in economic well-being for Coloradans. CO-GPI per capita slightly more than doubled from $9,366 to $20,197 between 1960 and 2011. Colorado's GDP, however, tripled from $13,454 to $40,206 over the same period.

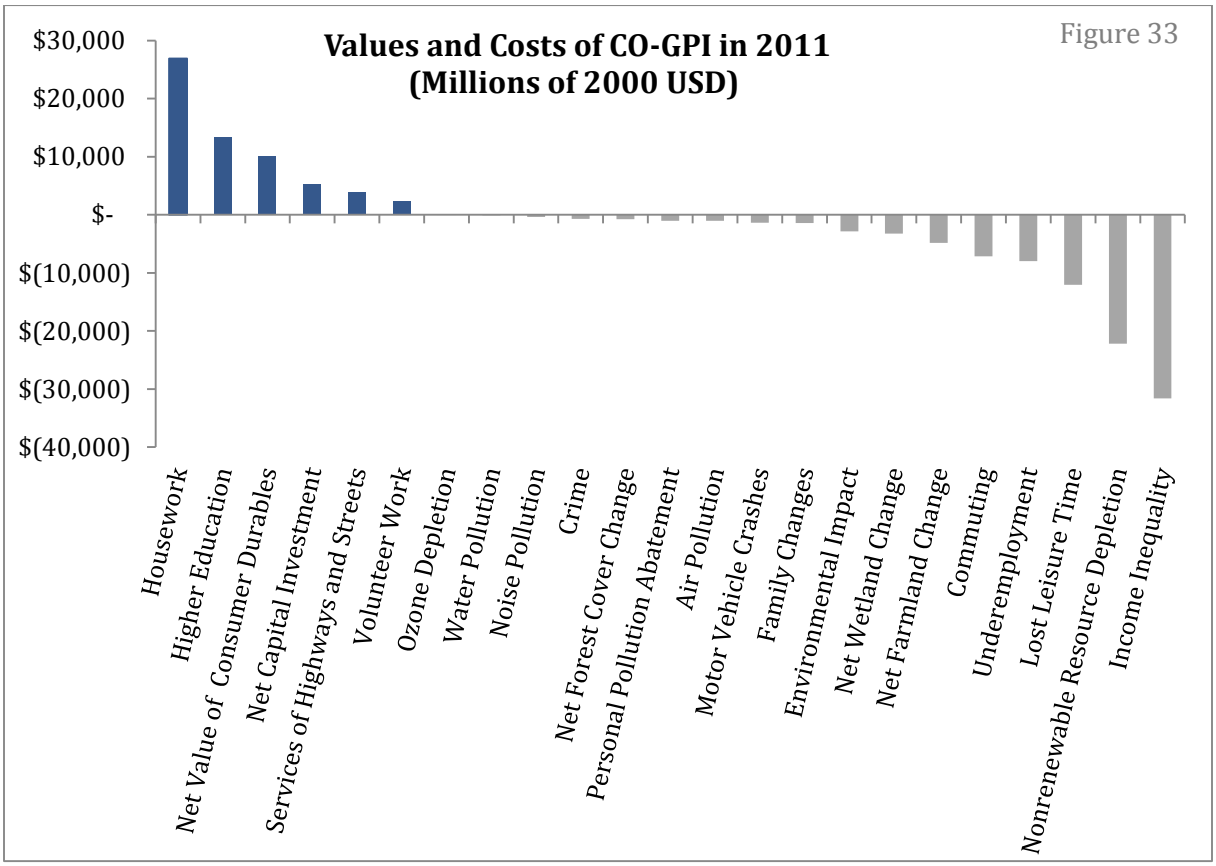
The divergence between GPI and GDP arrives because the GDP gains over the past few decades have come at costs, which aren't captured in GDP, like lost leisure time, increased underemployment, depletion of natural resources, increased noise pollution, increased cost of commuting and income inequality.

The GPI includes a number of indicators, ignored by GDP, that contribute to economic well-being. The top contributors include unpaid household work, the value of higher education and volunteer work. The Colorado GPI also includes factors that reduce economic well-being, chief among them being income inequality, non-renewable resource depletion, lost leisure time and underemployment.



The economic components of GPI, driven by large gains in personal consumption expenditures, maintained an upward trend. However, the value of social components — driven by decreased household labor, increased commuting time and lost leisure — made gains during the 1960s and early 1970s but has declined since. The costs to Colorado's GPI from environmental indicators also grew, driven by nonrenewable resource depletion.


CO-GPI and Components
Per Capita
Figure 32
$30,000
$25,000
$20,000
$15,000
$10,000
$5,000
$-
$(5,000)
$(10,000)
1960
1963
1966
1969
1972
1975
1978
1981
1984
1987
1990
1993
1996
1999
2002
2005
2008
2011
Colorado GPI
Economic
Environmental
Social


Values and Costs of CO-GPI in 2011
(Millions of 2000 USD)
Figure 33
$30,000
$20,000
$10,000
$-
$(10,000)
$(20,000)
$(30,000)
$(40,000)
Housework
Higher Education
Net Value of Consumer Durables
Net Capital Investment
Services of Highways and Streets
Volunteer Work
Ozone Depletion
Water Pollution
Noise Pollution
Crime
Net Forest Cover Change
Personal Pollution Abatement
Air Pollution
Motor Vehicle Crashes
Family Changes
Environmental Impact
Net Wetland Change
Net Farmland Change
Commuting
Underemployment
Lost Leisure Time
Nonrenewable Resource Depletion
Income Inequality

CHAPTER 7: HIGHLIGHTS OF THE COLORADO GPI

A Look at Economic Well-being

The economic indicators are the largest component of the Colorado GPI. The economic component hit its highest level in 2007. The recent recession has taken a toll on personal consumption expenditures and capital investment as well as increased the cost of underemployment in Colorado.

The economic components peaked in 2007 at $25,652. They were down to $22,640 in 2011.

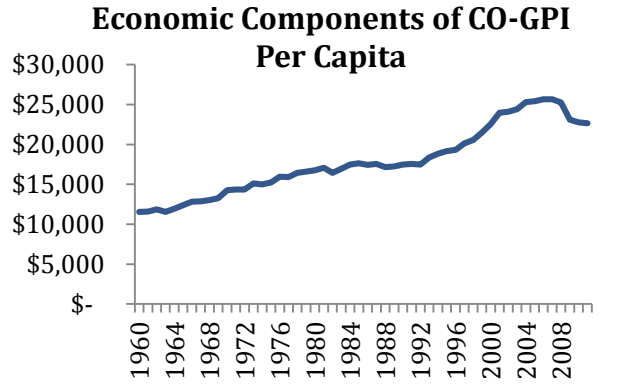


Figure 34

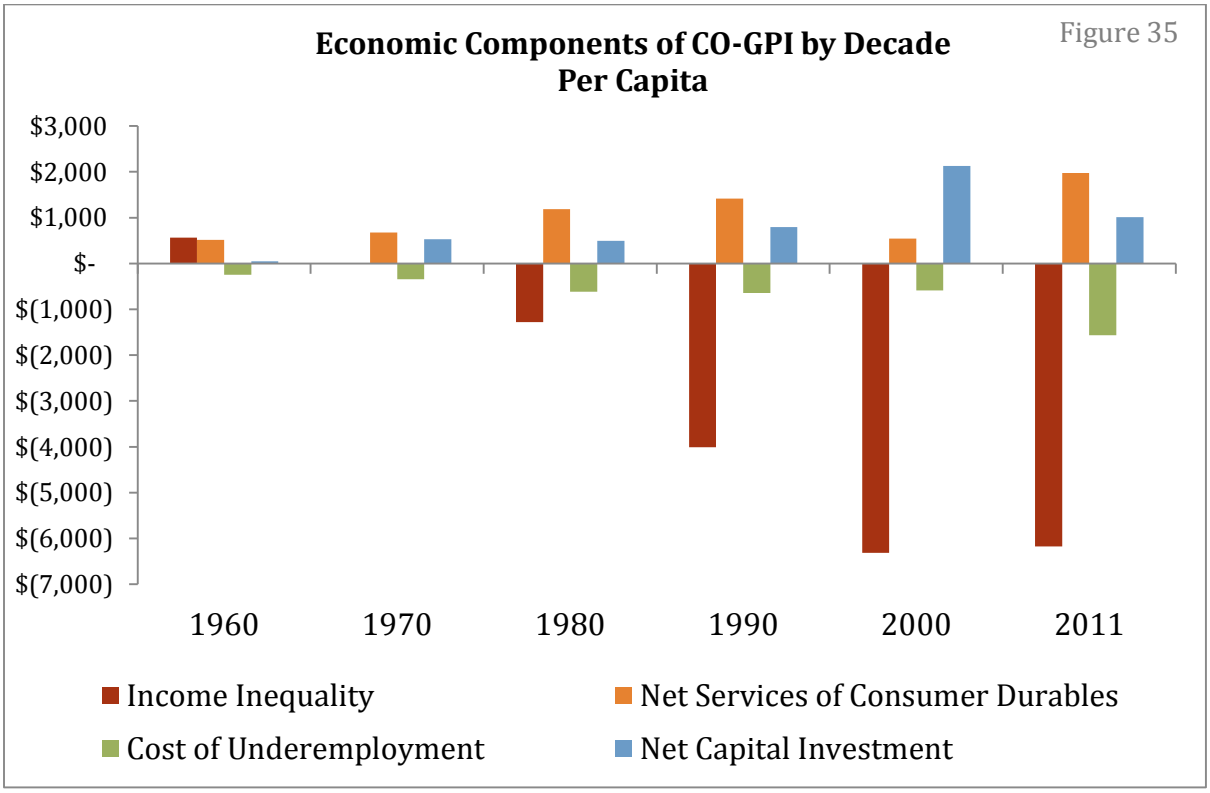


Figure 35

Where Colorado has had declining economic well-being

Income inequality has grown across the country as well as in Colorado. Figure 35 shows the growing deduction income inequality has on Colorado's GPI. The income distribution index in Colorado is now at its most unequal level since 1960. The U.S. Census Bureau in 2011 reported that the lowest-income 20 percent of population received only 3.4 percent of Colorado income while the top 20 percent received 49.1 percent (U.S. Census, 2011). While Colorado has an average level of income inequality compared to other states, Colorado has had an above-average level of inequality growth. From the late 1970s to early 2000s, Colorado had the eighth-highest level of growth of income inequality among the states (CBPP, 2013). Income inequality is the largest deduction on economic components. The per capita cost of income inequality in the Colorado GPI was $6,171, the largest deduction to economic well-being in the Colorado GPI.

There is a persistent level of underemployment in Colorado now that goes beyond the cyclical unemployment that accompanies recessions. And this level of underemployment has been slowly rising since 1960. This means more and more Coloradans are not able to work the desired amount they wish to. In 2011, there were more than 411,000 underemployed Coloradans each working on average 17 hours less per week than desired. Because underemployment correlates with the booms and busts of the economy, it's more intuitive to compare the cost of underemployment between years that were not during a recession. Thus, comparing 1960 to 2007, before the most recent recession, Colorado's per capita cost of underemployment grew from $247 to $712. The cost of underemployment in 2011 is the fourth largest deduction in the Colorado GPI. Whether caused by a job skills mismatch, lack of transportation or of family care, there has been an upward trend in the number of Coloradans who are unable to work their desired amount of hours.

Where Colorado has improved economic well-being

The starting point and biggest component of the Colorado GPI is personal consumption expenditures. The amount of goods and services Colorado consumes each year has nearly tripled since 1960, going from $10,644 in 1960 to $27,386 in 2011. Growth in durables and capital investment has also grown.

A Look at Environmental Well-being

The cost of the environmental components of the Colorado GPI continue to offset part of the gain in the economic components. The cost of environmental components peaked in 1973 at $9,890. Since then, Colorado has made a slight improvement. In 2011, the per capita environmental cost was $6,899.

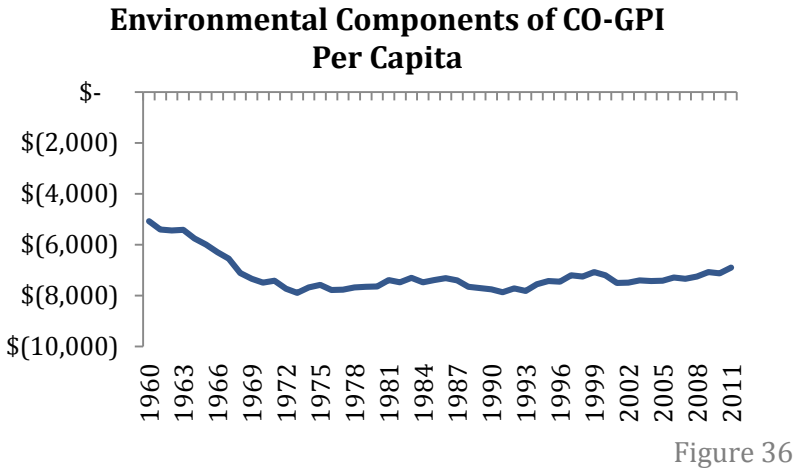


Figure 36

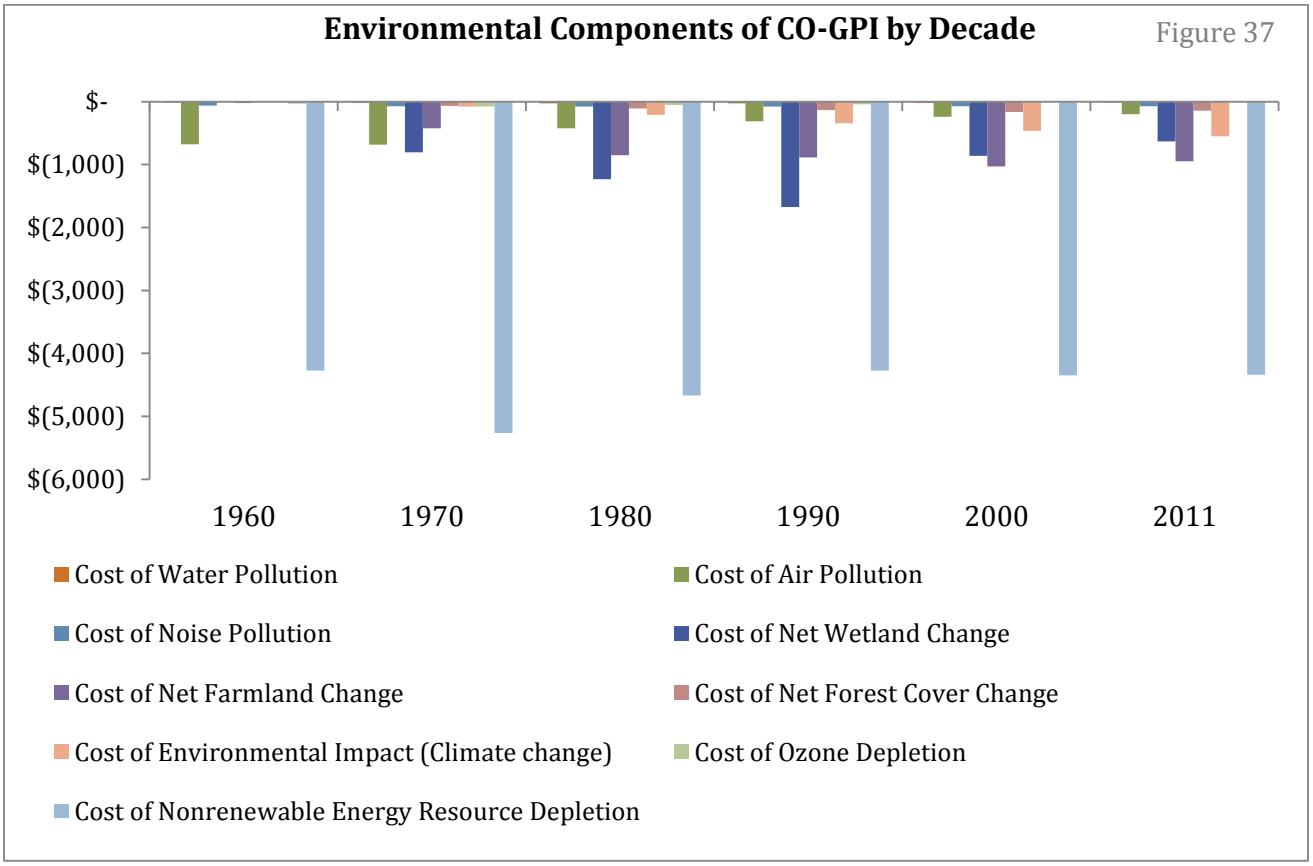


Figure 37

Where Colorado has had declining environmental well-being

The depletion of non-renewable resources like coal, natural gas and petroleum causes a net loss of wealth to Colorado since these are sources of income that cannot be sustained. Colorado has not made much progress on reducing the amount of non-renewable resources used by each Coloradan. In 1960, the per capita cost of non-renewable resources was $4,272, in 2011 that per capita cost now stands at $4,337. The cost of non-renewable resource depletion is the biggest detractor of the environmental indicators and the second largest total detractor from the Colorado GPI.

Colorado has lost acreage in forest land, farmland and wetlands since 1960. As the state adapts to increased population and urbanization, natural capital is depleted to make that progress. Since 1960, Colorado lost 12 percent of its wetlands, 19 percent of its farmland and 10 percent of its forests. The cost of lost forest acres, farm land and wetlands reduced per capita GPI by $1,723 in 2011.

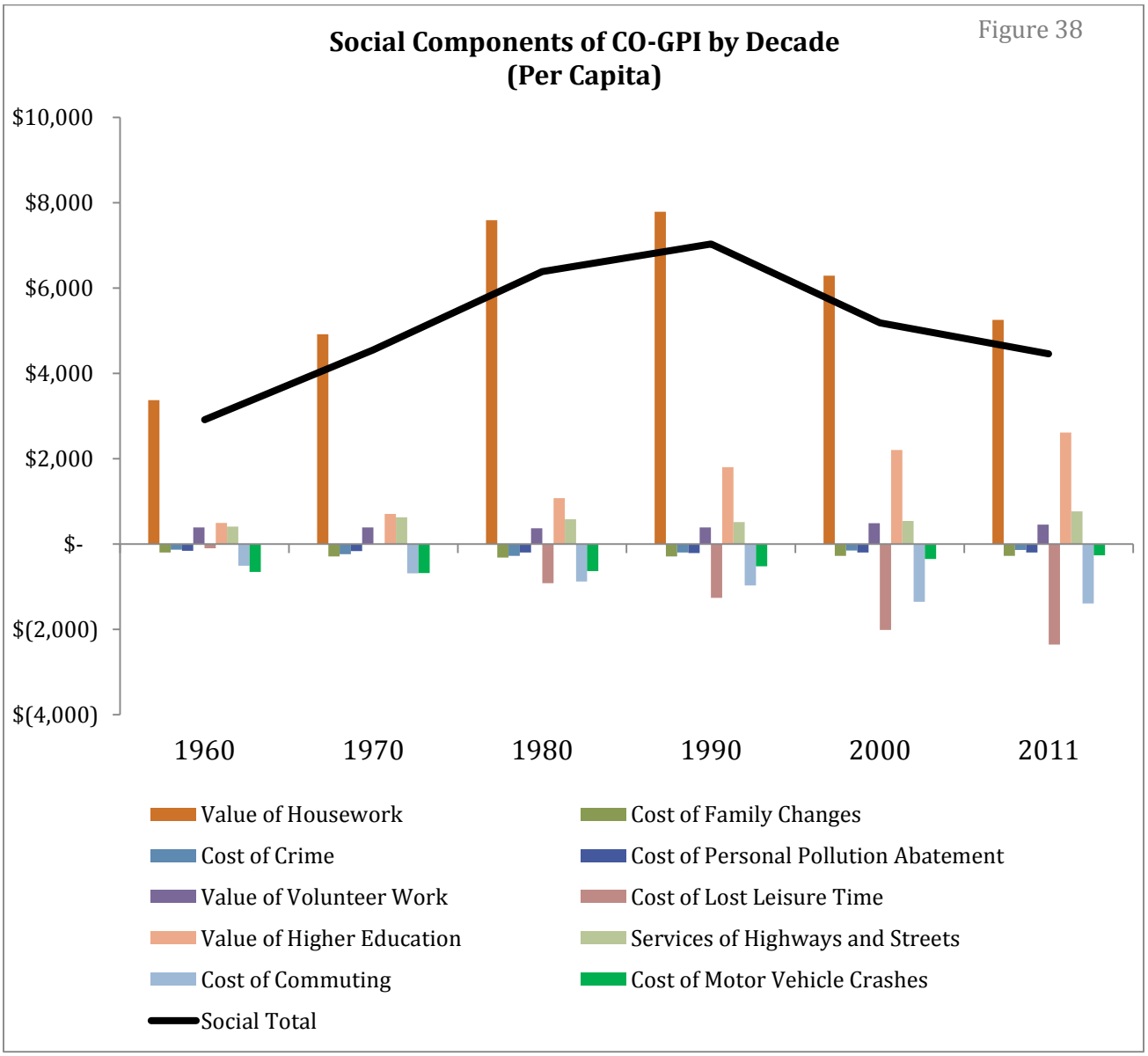
Where Colorado has improved environmental well-being

Although it still represents a negative drag on GPI, Colorado has made major gains in reducing air pollution. The cost of air pollution has been slowly falling since the early 1970s, which can in part be explained by the Clean Air Act of 1970. Nationwide, emissions of the six most common pollutants have fallen 72 percent since 1970 while the population has grown by 53 percent and vehicle miles traveled have increased by 165 percent (EPA). The cost per capita of air pollution in the Colorado GPI has fallen significantly from its peak in 1966 of $687 to $200 per capita in 2011.

Over the past two decades, Colorado has gained back acreage of wetlands. Colorado has gained approximately 120,000 acreages of wetlands since the low point in 1992. This is still below the 1960 acreage level. Because of this, the cost of lost wetlands fell from $6 billion in 1992 to $3.2 billion in 2011.

A Look at Social Well-being

The value of social components of GPI hit their peak in 1989, accounting for $7,094 per capita. A downward trend began after 1989. Now in 2011, the per capita social component of the GPI is only worth $4,456 as more household work is exported to the market sector and the costs of lost leisure and commuting continue to grow.



Where Colorado has had declining social well-being

Because GDP focuses only on market transactions, it ignores the value of free time on our well-being. The biggest weight on the social components of GPI come from the cost of lost leisure time. The cost of lost leisure began to grow around 1980. The average full-time worker in Colorado works 245 more hours a year then they did in 1969, the year in which leisure time was at its highest (between 1960 and 2011). That's more than six weeks.

The cost of commuting has become a growing weight on Colorado's well-being. Commuting costs have risen steadily since 1960. Mileage driven to work has risen from 23.3 miles in 1960 to 30.3 miles. It takes an average Colorado worker six more minutes to get to work than it did in 1960. The cost of commuting per capita has increased by 173 percent since 1960.

The biggest contribution to social well-being in the Colorado GPI is household work. The value of household work per capita peaked in 1986 at $8,004. The decline in the value of household labor over the past few decades should not be viewed as total negative, but should be viewed as an adjustment to the well-being in earlier years when most of household labor was done outside the market and not counted in personal consumption or GDP. Since many Coloradans began exporting more and more household work to the market (in the form of appliances, paying for household services and meals) the value of this gets captured in personal consumption.

Where Colorado has improved social well-being

The value of higher education has been a growing positive. The value of higher education in the Colorado GPI has growth by more than a factor of five since 1960 as more and more Coloradans are obtaining college degrees. In 1960, 5 percent of the Colorado population had a bachelor's degree or higher. In 2011, 25 percent had a bachelor's degree or higher. Colorado is the second most educated state in the country.

The cost of motor vehicles accidents has also improved over the past few decades. Since the peak in 1972, the cost of motor vehicle accidents per capita has fallen dramatically. In 2011, the cost of motor vehicle crashes were a third of that they were in 1972.

Although the cost of crime in Colorado rose considerably in the 1960s, peaking in 1981, this cost was cut in half between 1981 and 2011.

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APPENDIX A: DETAILED METHODS OF COLORADO'S GPI

Personal Consumption

The values for personal income since 1960 were obtained from the U.S. Bureau of Economic Analysis Regional Economic Accounts, found here: http://bea.gov/iTable/iTable.cfm?ReqID=70&step=1#reqid=70&step=1&isuri=1.
The percentage of income that goes toward consumption was estimated using the National Income and Product Accounts, 2.1 Personal Income and its Disposition, found here: http://bea.gov/iTable/iTable.cfm?ReqID=9&step=1#reqid=9&step=1&isuri=1. This method assumes that the rate of consumption in Colorado is the same as the national rate since consumption data is not available at the state level.

Income Distribution

Finding income inequality data at the state level is difficult. Other GPI studies use IRS data which has a limitation because of the omission of people whose earnings are less than a threshold level of income. Using IRS data, researchers generally focus on the top-income earner shares. Non-IRS data does not have this problem but the data is not available annually. For instance, the decennial census income data is only available every ten years. Only recently has the Current Population Survey provided Gini numbers for years 2006 forward.

Other GPI studies have used Nielsen's (1997) methodology for decennial years and used national data to piece together state level inequality numbers. Instead of extrapolating decennial data, which we view as less accurate, we use Frank (2008). The author calculates five measures of inequality (Atkinson Index, Gini Coefficient, Relative Mean Deviation, Theil Index, Top 10% and Top 1%) for each state up till 2005. You can find the data from Sam Houston State University here: http://www.shsu.edu/eco_mwf/inequality.html. Years 2006 and forward we rely on the U.S. Census Bureau's Gini figures.

In order to splice the CPS data with Frank's data from 1960-2005 we had to pair-down Frank's data to fit into the Census Bureau's data. (Franks Gini index for 2005 was .58 and Census Bureau's was .45). We reduced Frank's series by a factor of (.45/.58) in order to preserve the inequality ratio and thus be able to use Census Bureau's numbers for future years.

Next we index these inequality coefficients setting 1970 as the base year like other GPI studies since the U.S. experienced its lowest level of inequality that year. An index allows us to show relative change from year to year.

Personal Consumption Adjusted for Income Inequality

Personal consumption is adjusted for income inequality by dividing personal consumption by the income distribution index and multiplying by 100.

Services of Consumer Durables
The GPI views the original purchase price of consumer durables as a cost, and the services a consumer received from the product over its lifetime as a benefit. Like other GPI studies, the average consumer capital item is assumed to last 8 years which translates into a fixed depreciation rate of 12.5 percent. The Cost of Consumer Durables is used to impute that service of consumer durables. Added to the depreciation rate is the average interest rate of 7.5 percent. This is based on the fact that consumers could, instead of purchasing consumer durables, have invested their money at this interest rate. So the stock of durables is multiplied by a factor of 20 percent to get each year's services of those durables.

Cost of Consumer Durables
Data of spending on durables is not available at the state level, but is available at the national level from Bureau of Economic Analysis NIPA Table 2.3.5. The percentage of personal income spent on durable goods for the U.S. was used to calculate Colorado's spending on durables. This ratio was multiplied by person income in Colorado.

Cost of Underemployment
The total cost of underemployment equals the number of underemployed people multiplied by the hours of unprovided work per underemployed worker multiplied by average real wage rate.

All three factors needed to be calculated for Colorado. The Bureau of Labor Statistics began publishing underemployment state data in 2003. For prior years the unemployment rate was adjusted by a quadratic relationship, used by Costanza et al. (2004), to impute underemployment rate. The quadratic equation was developed via a regression using Schor's (1997) data, BLS data and another data point based on an assumption that if there is full unemployment, there would also have to be full underemployment as well.

The quadratic equation is: % (underemployed + unemployed) = -0.000087305*(100*Unemployment%)^2) + 0.969325*(100*Unemployment%)) + 3.941336.

Unprovided hours per underemployed worker come from Leete-Guy and Schor (1992). Extrapolation was used to compute the other year. Before 1969 and beyond 1989, the national and previous State GPI studies used the assumption of a continued growth of yearly unprovided hours by 0.59 percent per year.

Average hourly wage calculated by dividing employee compensation from BEA by employees, by weeks per year and by average hours worked per week. The same average real wage rate is used in the lost leisure indicator.

Net Capital Investment
The GPI calculates changes in the stock of capital by adding the amount of new capital stock (net stock of private nonresidential fixed reproducible capital from the BEA) and subtracting the capital requirement, which is the amount that maintains the same level of capital per worker. To calculate a capital requirement, the percent change in labor force each year is applied to the stock of capital. In order to smooth out yearly fluctuations, a five-year rolling average of changes in labor force and capital was used. Since State data was not available, national data was scaled down by population.

Cost of Water Pollution
To calculate trends in water pollution for Colorado, we used the 305(b) report on water quality from the Colorado Department of Public Health and Environment. The 2008 report had the highest percentage of assessed rivers and stream since their assessment methods changed in 2004. Using 2008 as the base year, figures for other years were estimated using the trends used by Costanza et al. (2004). Earlier years were interpolated following an assumption that water quality declined by 3 percent each year since there was no pollution control regulations in place then (years 1960-1972). A stable water quality level was assumed for 1973-1990 and a 2 percent per year improvement in water quality was assumed for 1991 to 2011. These trends were applied to the percentage impairments ratio, therefore a decline in water quality means an increase in the percent of water impaired.

We followed Maryland's GPI methodology for calculating the per capita value of clean water. Drawing on a review of a number of valuation studies, a value of $130 dollars per capita, or $562.5 million overall, in 2000 for clean water was adopted. The cost of water pollution is simply the value of clean water multiplied by the percentage of rivers and lakes that are impaired.

Cost of Air Pollution
Tons of pollution emitted in Colorado was obtained from the National Emissions Inventory Database provided by the Environmental Protection Agency, which provides detailed emissions data for various pollutants at the state level since 1990.
http://www.epa.gov/ttn/chief/eiinformation.html.
National EPA emissions trends from 1970 to 1990 were used to estimate Colorado's emissions which can be found
http://www.epa.gov/ttn/chief/trends/trends06/national_tier1_caps.xlsx.
For figures prior to 1970, Aneilski and Rowe's (1999) assumptions were used: air quality declined 2.4 percent per year in the 1960s. .

The cost per ton of pollution was drawn from Muller and Mendelsohn (2007), in which the authors estimated the marginal damage associated with emitting an additional ton of six different pollutants (ammonia, nitrogen dioxide, PM10, PM2.5, sulfur dioxide and volatile organic compounds). Most of the damage associated with air pollution comes from premature mortalities. Overall reductions in health account for 94 percent of the total damages of air pollution. The remaining 6 percent come from visibility loss, reduced

agricultural yield, reduced timber yield, accelerated depreciation of man-made material and impaired forest health. The per ton damages of NOX was $273 in 2000 dollars. PM10 damages were $544 per ton. PM2.5 damages were $3462 per ton. SO2 damages were $1261 per ton. VOC was $676 per ton.

Cost of Noise Pollution

National Data was scaled down based on Colorado's urban population, where noise effects are most likely to occur. Like other state GPI studies, we use a national cost of $14.62 billion for noise pollution in 1972 from an old WHO study. This estimate was extrapolated following Bagstad and Ceroni (2007) based on increases in the mitigation of noise pollution. Noise pollution was assumed to increase 3 percent per year from 1960-171 and 1 percent per year from 1973-2011, a period where noise abatement regulations help reduce the rate of deterioration.

Urban population data by decade for every state from 1900-1990 is available here http://www.census.gov/population/censusdata/urpop0090.txt. 2000 and 2010 data is available here http://dola.colorado.gov/demog-cms/content/census-data. Liner interpolation was used for the year between the decennial census data.

Cost of Net Wetland Change

Wetland acreage data for the years 1992, 2001 and 2006 were obtained from the National Land Cover Database. Historic wetland cover was retrieved from Mitsch and Gosselink (2007), which contains an estimate of wetland acreage in the mid 1980s and an estimate pre-settlement era circa 1780. Figures were converted from hectares to acres. Colorado had nearly 2 million acres of wetlands in 1780, and by 1985 Colorado was down to roughly 1 million acres. We assumed that wetland acreage did not begin to decline till the 1860s. Averaging 1 million lost wetland acres over the years between 1860 and 1985, meant Colorado lost 7,986 acres a year. This trend was used to estimate wetland acreage for years prior to 1985. Like the lost forest cover indicator, 1960 was set as the base year so lost acreage was calculated from the acreage in 1960. The cost of wetland change is a cumulative cost, so the losses from each year get added to the next year's cost.

Cost of Net Farmland Change

Farmland acreage is available from the U.S. Census of Agriculture found here: http://www.agcensus.usda.gov/Publications/Historical_Publications/index.php. The reports, which are available every five years, list acreage and value of acreage among other items.

The value of farmland lost per acre didn't seem translatable to Colorado who has much more farmland than Maryland. Instead of other GPI studies that used a value of $1,131 per lost acre, we utilized Colorado's "value per acre of land and building average per farm" from the same Census of Agriculture reports. Figures we adjusted to reflect 2000 dollars.

Cost of Net Forest Cover Change

Forest acreage data was only available for the years 1963, 1983, 1992, 2001 and 2006. The Forest Service began collecting data for Colorado in 2002. Reports are available here:
http://apps.fs.fed.us/fiadb-downloads/standardReports.html
http://www.fs.fed.us/rm/ogden/pdfs/historic_pubs/co_1987.pdf
http://www.fs.fed.us/rm/ogden/pdfs/historic_pubs/colorado.pdf

For lack of data, we use 1960 as the starting point for forest cover. This means that the calculation of the cost of forest land lost sets 1960 as the baseline and calculates loss in acreage from the 1960 figure. The value of lost forest acreage of $318.50 an acre follows the methodology used in Maryland's GPI report.

Cost of Environmental Impact

Total annual tons of carbon dioxide emitted in Colorado were calculated from the amount of carbon dioxide from the consumption of coal, natural gas, petroleum products, and wood and waste available from the Energy Information Administration (EIA). Emissions from petroleum, coal, natural gas and waste are recorded in BTUs. Following Maryland's GPI example, we used the average carbon intensities per British Thermal Unit (BTU) for the four main fuel types to estimate how much carbon dioxide is emitted from each energy source. The following values of pounds of carbon dioxide were used: 160 for petroleum, 120 for natural gas, 215 for coal and 197 for waste. These values were then converted to metric tons. Primary energy consumption was obtained from the Energy Information Association. Records are available from 1960-2011.
http://www.eia.gov/state/seds/?q_state_a=md&q_state=colorado

Cost of Ozone Depletion

We adopted and modified damage figures from Talberth et al. (2007) and scaled them by the ratio of Colorado Population to U.S. Population. We used a cost per ton of CFC emissions of $49,669 following Talberth et al. (2007) which combined data sets from the Alternative Fluorocarbons Environmental Acceptability Study, EPA, the United Nations Environmental Programme, and the U.S. Congress. Talberth uses a cumulative yearly cost of ozone depletion, though we, like more recent local GPI studies, do not use a cumulative cost. A large disparity occurs between the cumulative and non-cumulative methods because of the sharp drop in CFC emissions between 1990 and 2000. The national yearly cost was calculated as the difference between Talberth's yearly cumulative costs.

Cost of Non-Renewable Energy Resource Depletion

The cost of depleting nonrenewable resources was calculated by the cost it takes to replace those resources with renewables ones. The amount of coal, natural gas and petroleum was broken into two sector categories: electric sector and amount used outside of electric sector. This allows us to pin-point how much fuel can be replaced by solar and wind (for electric sector) and how much can be replaced by biofuel (non-electric sector). Electricity that is consumed that can be replaced by solar and wind power is multiplied by 8.75 cents

per kilowatt-hour following Costanza et al 2004; Bagstad and Ceroni 2007; Venetoulis and Cobb 2004 which utilize cost estimates from Makhijani 2007. Energy that is consumed that cannot be replaced by solar and wind and must be replaced by other biofuels is multiplied by $116 per barrel. The total BTU's of nonrenewable energy was converted to barrels of oil equivalent. Primary energy consumption was obtained from the Energy Information Association. Records are available from 1960-2011.
http://www.eia.gov/state/seds/?q_state_a=md&q_state=colorado

Value of Household work

The value of housework is monetized using a replacement cost method: by calculating how much a family would have to pay to hire someone else to do the equivalent household labor. The BLS has housekeeper specific Colorado data available from 2000 onward. Since such a wage rate was not available for most of the years, we calculated the ratio of this wage group to the average wage and applied this ratio to available Colorado average wage data to arrive at a housekeeper wage for years prior to 2000. Colorado maids and housekeeping cleaners had an average wage rate of $8.13 in 2000 which was 42.5 percent of the average wage in 2000. For years before 2000, the housekeeper wage was calculated as 42.5 percent of the average wage.

We followed the methodology and time-use data from the Maryland GPI and adapted it for Colorado. Several of these studies can be found at http://www.webuse.umd.edu/. Maryland selected two sets of time use surveys by the Department of Sociology at the University of Maryland (MTUS) that provided weekly hours for housework and child care in the years 1965, 1975 and 1984 to estimate trends in housework and parenting and applied these trends to the more current numbers from the American Time Use Survey (ATUS).

Since the ATUS only provides data for persons 15 and over, a ratio of those to overall population was taken from Census Data. Using ACS 2012 data, 80 percent of Coloradans are 15 and older. This is consistent with the Maryland GPI study.

Cost of Family Changes

The average number of children affected per divorce comes from the National Center for Health Statistics report, "Children in Divorce," which included average number of children affected per divorce up until 1984: http://www.cdc.gov/nchs/data/series/sr_21/sr21_046.pdf Divorce data for the years 1972-2011 was obtained from the Center for Disease Control and Prevention's Annual Summary of Births, Marriages, Divorces and Deaths http://www.cdc.gov/nchs/products/mvsr.htm. Divorce rates from 1990-2011 are available from the CDC at http://www.cdc.gov/nchs/data/dvs/divorce_rates_90_95_99-11.pdf. Linear interpolation was used for years when data wasn't available: 1995-1998 and 1961-1971. The national rate of divorce for 1960 was applied to Colorado's population to obtain an estimate for number of divorces in Colorado.

The cost of television viewing is estimated at $0.54 per hour following Costanza et al. (2004) and Bagstad and Ceroni (2007) which adapted Anielski and Rowe (1999).

The number of households with children comes from U.S. Census Decennial Census data for 1980, 1990, 2000 and 2010. Linear interpolation was used for the years between the decennial data. Household data for 1960 and 1970 was calculated as a percentage of total population using 1980's household with children to population ratio.

Two previous GPI studies were used to get U.S. household television viewing data. 2000 data was adopted from the Vermont GPI study, which drew this number for Nielsen Media Research data. Values were drawn for 1965, 1970, 1975, 1980, 1985, 1990, 1995, 1996 and 1997 from the 1998 GPI study, which used data from the Television Bureau of Advertising. Data was interpolated for years between these.

Cost of Crime

Crime numbers were taken from the Colorado Bureau of Investigation, combined with data from disastercenter.com for earlier years. Both were checked for consistency with annual crime reports. Each crime was then multiplied with the associated costs, both quality of life effects and property losses, from research by the National Institute of Justice at the U.S. Department of Justice into Victim Costs and Consequences.
Crime cost estimates come from the National Institute of Justice's report on victim costs found here https://www.ncjrs.gov/pdffiles/victcost.pdf. Cost were adjusted into 2000 dollars. Both quality of life effects and property value are included in the cost of each crime.

Cost of Personal Pollution Abatement

The cost of household pollution abatement is comprised of automobile emissions abatement, sewage/septic systems and solid waste removal. Automobile emissions abatements were calculated in the same way as Costanza et al. (2004) and Bagstad and Ceroni (2007) using the registration data for cars and trucks.

The number of new vehicles comes from data on the number of registered vehicles in Colorado from U.S. Department of Transportation Federal Highway Administration. https://www.fhwa.dot.gov/policy/ohpi/hss/hsspubsarc.cfm. The Department of Transportation assumes an average lifespan of a car of 13 years, which means that an average of 7.69 percent of cars will be retired. New cars are the change in the stock plus this number. The number of new vehicles is then multiplied by the costs for air filters and catalytic converters. Following Bagstad and Ceroni (2007), catalytic converters are valued at 100 dollars and air filters at 8.50. However the catalytic converters are only added from 1977, phased in over five years, since they were previously not widely used.

Data on houses with septic or sewer were only available for 1970, 1980 and 1990 http://www.census.gov/hhes/www/housing/census/historic/sewage.html. Other values were interpolated, and for previous and following years, the ratio of houses with sewer/septic to overall housing units was used. New systems were assumed to cost $4,000 and $200 for cleaning costs.

For the sewer costs, the assumption of 250 gallons of sewer flow per day per household was adopted, which is generally used by Maryland's GPI study. This translates to 91,250 gallons per household per year. Sewer rates in Colorado and across the Front Range greatly vary, from 2.81 dollars per 1,000 gallons in Louisville to over $10 in Arapahoe County http://www.denverwater.org/BillingRates/RatesCharges/2013Rates/. For a conservative estimate, a rate of $4 per 1,000 gallons was adopted which mirrors the Maryland GPI study.

Solid waste data was only available from 1999 to 2006. For earlier years, the national trend in per capita waste was applied to Colorado's population. As a cost of waste disposal a value of 100 dollars per ton was used, following Franklin and Associates (1997). Find the latest EPA study on solid waste here http://www.epa.gov/wastes/nonhaz/municipal/pubs/msw2009-fs.pdf.

Value of Volunteer Work

The Current Population Survey (CPS) included supplements on volunteering in 1974, 1989 and 2002 onwards. Data from 1974 was not available for Colorado. U.S. residents in recent years spent 32.7 hours volunteering, while Colorado residents spent 36.5 hours. We used this ratio to estimate Colorado volunteer data from national data. Volunteer hours before 1974 were interpolated using population growth. http://www.volunteeringinamerica.gov/CO Monetary value is calculated by applying a wage rate to the volunteer hours. Independent Sector calculates volunteer wage rates from 1980. http://www.independentsector.org/volunteer_time#sthash.BKmtDarH.dpbs. Since the Colorado volunteer wage rate in 2011 is $22.43 (the national wage rate is $21.78), we increased the 2000 number from $15.68 (national) to $16.15 (Colorado) since calculations are done in 2000 dollars.

Cost of Lost Leisure Time

We used the data points from Leete-Guy and Chor (1992) on yearly hours worked per unconstrained worker. We then adopted the assumption of a decline in work hours by 0.3 percent before 1969 from Talberth 2007, as well as the assumption of an annual rise in working hours by 5.2 hours between 1989 and 1994 based on Mishel et al., up to 2002. For recent years after 2001, we use trends from the American Time Use Survey (ATUS) of work hours for the population 15 and older. To convert the growth in total work hours to growth in hours per unconstraint worker, we divided growth in hours from 2003 to 2008 by 60 percent since approximately 60 percent of workers 15 and older are unconstrained. This allowed us to establish a value of 3.2 hours of work per unconstrained worker growth per year. Lost leisure was calculated as the difference between hours worked in the year with most leisure — 1969 — and other years.

Value of Higher Education

The number of bachelor's degree holders was obtained from decennial census data for Colorado. More recently (2005 beyond) data is available on a yearly basis. Polynomial interpolation was used for the years between the decennial data.

The value of a bachelor's degree used in our model is $10,500 from McMahon (2010). Other studies use $16,000 from Hill et al. (2005). We feel that this double counts some of the benefits of higher education, particularly the income effects of higher education that are already counted in personal consumption.

Services and Highways and Streets

Since state stocks of highways and streets were not available, we used numbers on the overall miles of highways in the United States and in Colorado to scale the value for Colorado. National mileage can be found here http://www.census.gov/compendia/statab/cats/transportation.html. Colorado mileage was obtained from a number of sources: the Colorado Department of Transportation http://www.coloradodot.info/library/FactBook, CDOT's annual reports and Federal Highway Administration http://www.fhwa.dot.gov/policy/ohpi/hss/hsspubsarc.cfm.

Cost of Commuting

Local fares were difficult to obtain because of significant gaps in data. Data was available from the National Transit Database on fare revenue across Colorado going back to 2002. http://www.ntdprogram.gov/ntdprogram/datbase/2011_database/NTDdatabase.htm. NTD has both rural and urban fares (urban fares were available to 2002 while rural fares were only available for years after 2007). We used a ratio of 5.8 percent to extrapolate rural fares back to 2002 based on proportion of urban fares. From Costanza et al. (2007) we extrapolated figures for commuting fares by the trend found in the "1996 Motor Vehicle Facts and Figures" AAMS (1996), in which an increase of 25 percent was observed during the decade 1984-1994. Thus a 25 percent rise per decade was assumed with linear interpolation for remaining years. RTD fares were available from 2002 onwards available from RTD Financial Reports as a double check that the NTD has correct data on Urban and Rural fares in Colorado.

We assumed 250 work days as a base from Bagstad and Ceroni (2007). The percentage of workers driving and carpooling was available for recent years. This was applied to each year's labor force to derive the number of Colorado commuters per year.

The American Community Survey began providing data on travel time to work for Coloradans in 2003. National trends in commute time were applied to Colorado's statistics to estimate commute time for years before 2003. National mean travel time went from 21.7 minutes to 22.4 minutes between 1980 and 1990 and to 24.4 minutes in 2000.

Cost of Motor Vehicle Crashes

The cost of crashes is calculated from three types of accident data: fatal crashes, crashes with non-fatal injuries and property-damage-only crashes. Data on accidents on public roads are available for 1967-1992 from the Federal Highway Administration https://www.fhwa.dot.gov/policy/ohpi/hss/hsspubsarc.cfm. CDOT began publishing vehicle accident data in 1996 http://www.coloradodot.info/library/traffic/traffic-manuals-guidelines/safety-crash-data/accident-rates-books-coding. Property Damage only accidents were reported for the years 2000 onward. To estimate for prior years, the ratio of property-

damage-only crashes to injury crashes from 2003 was used to tabulate the prior years. Projections for non-fatal-injury crashes in 2005 followed different reporting rules and thus a notable reduction in the number reported. To account for this, we used the ratio of injury crashes to property damage only crashes in 2003 and applied it to the property-damage-only crashes going forward to tabulate an injury figure for 2004 onward.

Using the methodology of previous studies, values per accident from the National Safety Council (NSC) Injury Facts 2004 were used. The NSC calculates a cost of $1,024,000 per death, $36,000 per injury and $6,400 per property damage accident.

APPENDIX B: DETAILED CO-GPI RESULTS

Colorado GPI Components in Billions 2000 USD								
	+	+ or -	+	+	-	-	+ or -	-
	Personal Consumption Expenditures	**Income Distribution Index**	**Adjusted Personal Consumption**	**Services of Consumer Durables**	**Cost of Consumer Durables**	**Cost of Underemployment**	**Net Capital Investment**	**Cost of Water Pollution**
1960	18.83	0.95	19.83	3.50	2.59	0.44	0.09	0.03
1961	19.83	0.96	20.59	3.65	2.56	0.52	0.19	0.03
1962	20.63	0.95	21.78	3.77	2.81	0.49	0.31	0.03
1963	21.38	0.99	21.55	3.96	3.03	0.53	0.40	0.04
1964	22.38	0.99	22.72	4.10	3.24	0.53	0.49	0.04
1965	23.50	0.99	23.69	4.29	3.52	0.52	0.68	0.04
1966	24.49	1.00	24.55	4.50	3.65	0.52	0.90	0.04
1967	25.22	1.01	24.91	4.79	3.68	0.55	0.96	0.04
1968	26.92	1.03	26.15	5.02	4.10	0.58	1.16	0.05
1969	28.30	1.05	27.03	5.32	4.24	0.61	1.21	0.05
1970	29.87	1.00	29.87	5.65	4.15	0.77	1.17	0.05
1971	32.40	1.02	31.77	5.92	4.73	0.93	1.05	0.06
1972	35.55	1.06	33.56	6.26	5.38	1.01	1.04	0.06
1973	38.23	1.04	36.65	6.69	5.86	1.03	1.22	0.06
1974	38.66	1.08	35.74	7.16	5.40	1.11	1.68	0.06
1975	39.54	1.04	37.86	7.51	5.44	1.45	0.97	0.07
1976	42.08	1.03	40.90	7.86	6.17	1.45	0.91	0.07
1977	44.55	1.06	42.14	8.27	6.70	1.64	0.87	0.07
1978	47.55	1.07	44.62	8.77	7.11	1.58	0.73	0.07
1979	49.12	1.07	45.96	9.36	6.99	1.51	0.47	0.07
1980	49.32	1.08	45.61	9.81	6.36	1.78	1.43	0.07
1981	50.86	1.07	47.64	10.01	6.40	1.79	1.34	0.08
1982	52.61	1.10	47.91	10.12	6.42	2.38	1.08	0.08
1983	56.47	1.11	51.05	10.32	7.29	2.33	1.39	0.08
1984	58.67	1.10	53.17	10.69	8.04	2.00	1.58	0.08
1985	60.71	1.12	54.44	11.06	8.48	2.20	1.83	0.08
1986	62.19	1.14	54.46	11.42	9.04	2.61	2.17	0.08
1987	62.61	1.16	54.07	11.80	8.95	2.61	2.98	0.08
1988	63.47	1.21	52.24	12.20	9.01	2.36	2.86	0.08
1989	65.11	1.25	52.19	12.73	8.96	2.20	2.69	0.08
1990	65.87	1.25	52.62	13.24	8.56	2.13	2.62	0.08
1991	67.30	1.25	53.78	13.66	8.11	2.29	2.36	0.09
1992	70.55	1.26	56.01	13.83	8.50	2.59	2.38	0.09
1993	75.53	1.23	61.57	13.92	9.32	2.52	2.69	0.09
1994	80.33	1.22	65.79	14.09	10.29	2.34	2.92	0.09
1995	84.38	1.23	68.76	14.34	10.76	2.35	3.37	0.09
1996	88.33	1.26	70.32	14.70	11.34	2.53	4.61	0.09
1997	92.85	1.24	74.64	15.17	11.95	2.44	5.41	0.09
1998	98.71	1.27	77.84	15.76	13.04	2.70	6.72	0.09
1999	106.86	1.29	82.91	16.66	14.50	2.70	8.43	0.09
2000	115.86	1.31	88.55	17.94	15.60	2.54	9.22	0.09
2001	120.31	1.26	95.77	19.36	16.02	3.02	9.95	0.09
2002	121.88	1.25	97.48	20.70	16.37	3.87	10.22	0.09
2003	122.48	1.23	99.90	21.92	16.01	4.42	9.26	0.09
2004	126.29	1.22	103.52	22.97	16.24	4.12	9.65	0.09
2005	131.26	1.26	104.37	23.95	16.51	3.89	9.73	0.09
2006	135.54	1.27	107.05	24.86	16.52	3.61	9.27	0.09
2007	138.49	1.27	108.90	25.55	16.49	3.42	8.69	0.09
2008	139.08	1.29	108.16	25.95	15.22	4.45	9.02	0.09
2009	133.80	1.27	104.98	25.87	13.95	7.08	4.96	0.09
2010	137.69	1.29	107.08	25.46	14.65	8.17	5.25	0.09
2011	140.13	1.29	108.55	25.12	15.00	8.00	5.17	0.09

-	-		-	-	-		-	+
Cost of Air Pollution	**Cost of Noise Pollution**	**Cost of Net Wetland Change**	**Cost of Net Farmland Change**	**Cost of Net Forest Cover Change**	**Cost of Environmental Impact**	**Cost of Ozone Depletion**	**Cost of Nonrenewable Energy Resource Depletion**	**Value of Housework**
1.20	0.11	-	0.03	-	-	0.06	7.56	5.97
1.22	0.11	0.18	0.07	0.02	-	0.06	8.27	6.32
1.25	0.12	0.36	0.11	0.03	-	0.08	8.36	6.49
1.28	0.12	0.54	0.15	0.05	-	0.09	8.23	6.67
1.31	0.13	0.72	0.19	0.06	-	0.09	8.79	6.88
1.35	0.13	0.90	0.32	0.08	0.02	0.11	8.97	6.99
1.38	0.14	1.08	0.45	0.09	0.05	0.11	9.31	7.38
1.41	0.14	1.26	0.59	0.11	0.07	0.12	9.70	8.01
1.44	0.15	1.43	0.73	0.12	0.11	0.13	10.93	8.98
1.48	0.15	1.61	0.87	0.14	0.14	0.15	11.32	9.84
1.52	0.16	1.79	0.95	0.15	0.17	0.17	11.70	10.93
1.49	0.17	1.97	1.04	0.17	0.20	0.18	11.82	12.60
1.45	0.18	2.15	1.13	0.19	0.25	0.21	12.96	14.97
1.41	0.18	2.33	1.24	0.20	0.30	0.24	13.72	17.14
1.37	0.19	2.51	1.34	0.22	0.33	0.24	13.26	17.51
1.34	0.19	2.69	1.42	0.23	0.37	0.20	13.09	18.27
1.31	0.20	2.87	1.50	0.25	0.43	0.19	13.65	19.96
1.29	0.20	3.05	1.59	0.26	0.50	0.17	13.80	20.85
1.27	0.21	3.23	1.68	0.28	0.54	0.16	13.82	21.96
1.25	0.22	3.41	2.08	0.29	0.58	0.15	13.76	22.15
1.22	0.22	3.59	2.47	0.31	0.61	0.15	13.58	22.07
1.20	0.22	3.77	2.86	0.32	0.64	0.17	12.76	22.81
1.18	0.23	3.94	3.25	0.34	0.69	0.14	13.04	23.90
1.15	0.23	4.12	3.17	0.35	0.71	0.17	12.89	23.98
1.13	0.23	4.30	3.10	0.37	0.80	0.19	13.50	24.28
1.11	0.24	4.48	3.03	0.38	0.85	0.18	13.34	25.09
1.09	0.24	4.69	2.97	0.39	0.88	0.21	13.11	25.91
1.08	0.24	4.90	2.91	0.40	0.92	0.20	13.37	26.02
1.06	0.25	5.11	2.92	0.42	1.00	0.25	13.88	25.93
1.04	0.25	5.32	2.93	0.43	1.06	0.21	13.92	25.93
1.03	0.25	5.54	2.94	0.44	1.13	0.13	14.13	25.75
1.04	0.26	5.75	2.94	0.45	1.19	0.11	14.81	26.13
1.05	0.27	5.96	2.95	0.47	1.26	0.10	14.85	27.01
1.07	0.27	5.68	3.11	0.50	1.37	0.09	16.06	27.12
1.08	0.28	5.40	3.28	0.53	1.44	0.05	15.97	26.60
1.10	0.29	5.12	3.45	0.56	1.48	0.02	16.30	26.48
1.11	0.29	4.84	3.63	0.59	1.59	0.00	17.07	26.94
1.06	0.30	4.57	3.81	0.62	1.63	0.00	16.85	27.76
1.08	0.30	4.29	4.02	0.65	1.75	0.00	17.67	28.85
0.90	0.31	4.01	4.24	0.68	1.82	0.00	17.85	30.18
1.04	0.32	3.73	4.45	0.71	2.01	0.00	18.83	27.22
0.90	0.32	3.45	4.67	0.74	2.23	0.00	20.81	27.02
1.27	0.32	3.43	4.90	0.74	2.23	0.00	20.64	27.07
1.07	0.33	3.41	4.82	0.74	2.31	0.00	20.77	26.38
0.88	0.33	3.39	4.74	0.74	2.42	0.00	21.41	26.29
0.68	0.34	3.37	4.65	0.74	2.52	0.00	21.99	26.09
0.72	0.34	3.35	4.57	0.74	2.61	0.00	22.00	25.57
0.76	0.35	3.33	4.48	0.74	2.76	0.00	22.80	26.79
0.80	0.35	3.31	4.57	0.74	2.77	0.00	22.85	25.29
0.88	0.35	3.28	4.66	0.74	2.73	0.00	22.46	27.43
0.95	0.36	3.26	4.75	0.74	2.86	0.00	22.98	27.34
1.02	0.36	3.24	4.84	0.74	2.82	0.00	22.19	26.89

-	-	-	+	-	+	+	-	-
Cost of Family Changes	**Cost of Crime**	**Cost of Personal Pollution Abatement**	**Value of Volunteer Work**	**Cost of Lost Leisure Time**	**Value of Higher Education**	**Services of Highways and Streets**	**Cost of Commuting**	**Cost of Motor Vehicle Crashes**
0.35	0.24	0.28	0.68	0.18	0.88	0.73	0.90	1.16
0.38	0.27	0.29	0.71	0.17	0.90	0.77	0.96	1.17
0.41	0.31	0.30	0.73	0.15	0.93	0.83	1.01	1.19
0.45	0.31	0.30	0.75	0.14	0.97	0.88	1.05	1.20
0.48	0.28	0.31	0.76	0.12	1.02	0.92	1.10	1.21
0.51	0.25	0.32	0.77	0.10	1.08	0.99	1.14	1.23
0.54	0.28	0.33	0.77	0.08	1.16	1.07	1.22	1.24
0.57	0.30	0.34	0.79	0.06	1.24	1.14	1.29	1.25
0.60	0.40	0.34	0.82	0.03	1.33	1.18	1.37	1.41
0.63	0.43	0.36	0.84	-	1.43	1.26	1.45	1.44
0.65	0.53	0.36	0.86	0.04	1.57	1.39	1.53	1.52
0.68	0.58	0.38	0.89	0.08	1.66	1.42	1.66	1.53
0.71	0.70	0.40	0.93	0.13	1.79	1.49	1.83	1.73
0.76	0.70	0.42	0.96	0.19	1.93	1.65	1.99	1.58
0.78	0.62	0.44	0.98	0.49	2.09	1.96	1.98	1.46
0.80	0.72	0.46	1.00	0.79	2.25	1.78	1.99	1.49
0.85	0.67	0.48	1.01	1.17	2.42	1.65	2.11	1.63
0.93	0.68	0.50	1.03	1.59	2.60	1.57	2.24	1.77
0.88	0.77	0.54	1.04	2.09	2.79	1.53	2.42	1.80
0.88	0.71	0.54	1.06	2.58	3.00	1.59	2.53	1.83
0.93	0.82	0.58	1.07	2.66	3.12	1.68	2.55	1.84
0.94	0.90	0.58	1.09	2.85	3.43	1.75	2.66	2.03
0.92	0.76	0.63	1.10	3.03	3.66	1.72	2.76	1.89
0.99	0.78	0.63	1.12	3.17	3.90	1.62	2.83	1.94
0.97	0.74	0.66	1.14	3.39	4.16	1.55	2.97	1.86
0.99	0.78	0.66	1.15	3.54	4.42	1.58	3.04	1.85
0.99	0.90	0.66	1.17	3.67	4.69	1.68	3.09	1.86
0.98	0.78	0.67	1.18	3.72	4.97	1.73	3.08	1.81
0.98	0.74	0.70	1.20	3.83	5.27	1.70	3.11	1.69
0.98	0.64	0.72	1.21	3.96	5.57	1.69	3.16	1.71
0.97	0.65	0.71	1.30	4.17	5.97	1.69	3.22	1.73
1.01	0.80	0.71	1.38	4.45	6.20	1.67	3.38	1.69
1.04	0.86	0.72	1.46	4.83	6.54	1.67	3.60	1.72
1.06	0.82	0.77	1.54	5.21	6.88	1.68	3.83	1.67
1.07	0.79	0.74	1.62	5.60	7.23	1.76	4.06	1.63
1.10	0.82	0.79	1.71	6.01	7.59	1.96	4.29	1.58
1.11	0.77	0.88	1.79	6.45	7.97	1.99	4.54	1.53
1.14	0.70	0.84	1.87	7.09	8.35	2.10	4.93	1.49
1.17	0.78	0.84	1.95	7.88	8.74	2.16	5.41	1.74
1.21	0.75	0.91	2.03	8.67	9.15	2.25	5.88	1.59
1.19	0.65	0.85	2.12	8.72	9.53	2.34	5.86	1.51
1.23	0.75	1.01	2.20	8.99	9.74	2.38	5.93	1.66
1.24	0.82	0.90	1.92	9.26	10.08	2.43	6.00	1.74
1.23	0.82	0.91	2.52	9.60	10.42	2.44	6.21	1.56
1.27	0.87	0.92	2.40	9.99	10.76	2.74	6.38	1.56
1.28	0.83	0.93	2.64	10.32	11.05	2.96	6.52	1.44
1.30	0.76	0.95	1.98	10.89	11.23	3.29	6.75	1.58
1.28	0.72	0.96	3.16	11.32	11.77	3.59	7.01	1.52
1.29	0.72	0.96	2.33	11.54	12.20	3.68	7.18	1.45
1.32	0.73	0.96	2.61	11.81	12.41	3.71	7.25	1.40
1.34	0.65	0.98	2.65	11.97	12.72	3.79	7.04	1.33
1.42	0.72	1.02	2.34	12.07	13.37	3.92	7.13	1.35