The 2018 Vermont Genuine Progress Indicator Report

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The Vermont Genuine Progress Indicator Project

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Genuine Progress Indicator Report

by

Eric Zencey

Table of Contents

List of Graphs

List of Tables

Vermont GPI 2015: Executive Summary

Brief Introduction

In 2012, Vermont became the first state in the nation to legislate the compilation and policy use of an alternative indicator of macroeconomic performance known as the Genuine Progress Indicator (GPI). (Maryland was the first to do so through Executive Order.) While Gross State Product estimates the dollar value of the gross receipts of the economy, the GPI estimates the dollar value of the net economic benefit produced by economic activity in the state. GPI achieves this net figure by taking a basic measure of economic welfare--Personal Consumption Expenditure--and adjusting it in light of various kinds of costs and benefits that GSP ignores. To accomplish this, GPI compilations assign dollar values to otherwise uncounted costs like degradation of natural resources and to otherwise uncounted benefits like volunteer work and the domestic production (cooking, childcare, and the like) that Vermonters do for themselves. (See Table 2 for a list of the costs subtracted and benefits added to produce GPI.)

Since the enabling legislation was passed in 2012, researchers at the University of Vermont's Gund Institute for Ecological Economics have produced an historical estimate and analysis of VT GPI from 1960 to 2011 and annual estimates for most succeeding years. The current study, produced at UVM under the auspices of the Center for Rural Studies, provides an estimate for 2015, the most recent year for which reasonably complete data are available. It also includes trend analysis using revised estimates for 2000-2015 which are based on significant methodological improvements.

Key Findings

- **The GPI climbed to $19.773 billion, an increase of 7.0% over the previous year.** Gross State Product grew by 2.12% for the year. (See Fig. 1)

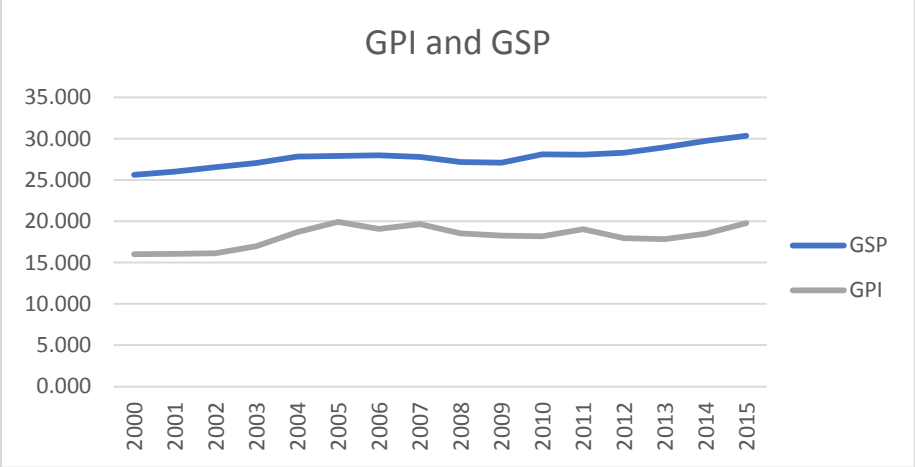

Figure 1: Genuine Progress Indicator and Gross State Product for Vermont, 2000-2015, in constant 2015 dollars.

- **The GPI stands at about 66% of the state's Gross State Product (GSP) of $30.355 billion**.[1] Some gap between the two figures is to be expected, as gross receipts usually exceed net benefits.[2] The size of the gap can be meaningful. Generally, the largest contributor to the GPI-GSP gap is the uncounted environmental costs imposed by economic activity on citizens of the state. Vermont's experience here compares favorably to that of other states. A fifty-state GPI study done in 2014, using data current to 2012, found that Vermont had the 16th smallest gap between the two figures.[3] Within New England, though, Vermont lagged behind four of its six

[1] All figures are reported in 2015 dollars, adjusted for inflation using the Northeast Consumer Price Index.
[2] Earlier in the processes of economic development GPI tends to exceed GDP. For Vermont, the cross-over year was 1970. See Erickson et al., "Findings and Recommendations: Vermont GPI 1960-2011," report to the legislature and Secretary of Administration, Gund Institute for Ecological Economics, 2012.
[3] Erickson et al., "Fifty-State GPI Table," Gund Institute for Ecological Economics, University of Vermont, 2015.

regional neighbors, edging out New York (22nd) and Connecticut (18th) but standing behind Massachusetts, Rhode Island, New Hampshire and Maine. (See Table 1.)

- **The GPI trend for the years 2013-2015 is positive.** The 2015 GPI increase of 7.0% over the 2014 figure is more than triple the growth in GSP. In 2014, GPI grew by 3.6% over 2013, a percentage point higher than GSP growth of 2.6%.

State	GPI	GSP	GPI as % of GSP
Maine	38.17	45.99	83.01%
New Hampshire	45.67	56.74	80.5%
Rhode Island	33.05	43.77	75.5%
Massachusetts	260.6	353.7	73.67%
Vermont	**15.84**	**23.91**	**66.23%**
Connecticut	126.74	197.20	64.27%
New York	643.12	1,038.5	61.92%

Table 1: Comparison of New England states by percentage gap between GSP and GPI. In general, a larger gap indicates a larger environmental cost for the state's economy.

- **The results for a longer time period are less salutary.** Over the past decade GPI declined slightly, 0.9%, from $19.94 to $19.77 billion. In contrast GSP grew by 8.7% in those years. Among the indicators exerting a downward pressure on GPI over the decade were the Cost of Non-Renewable Energy Resource Depletion (up by $1.1 billion) and the adjustment for income inequality, which rose by $1.8 billion.
- **Increasing income inequality is the largest single drag on the GPI.** Increases in the total income of Vermonters can't promote the general welfare if they aren't generally shared. GPI includes a deduction for increasing concentration of income. In 2015, the income adjustment charge was $6.48 billion, up 5.42% over the year before. In the ten years since 2005 the charge has increased 40%. In keeping with national trends, well-to-do Vermonters are seeing their incomes increase while Vermonters at the lower and middle parts of the income scale are not.

The costs and benefits that GPI counts--and that GSP ignores--fall into three broad categories: economic, environmental, and social. A list of indicators in each category, and their raw values and 2014-2015 percentage change, is given in Table 2. This executive summary offers a brief review of significant findings in each category. A fuller description of results for each indicator is given in the body of this report.

Economic Elements of the GPI (summary)

Personal Consumption up slightly. GPI calculations start with a base figure: the amount of money Vermonters spent on Personal Consumption. GPI improvement from 2014-2015 was stimulated by a small rise in Personal Consumption Expenditures, as Vermonters spent $0.5 billion more, an average of $718.75 per Vermonter. This amounted to a 1.0% increase over the previous years' figure.

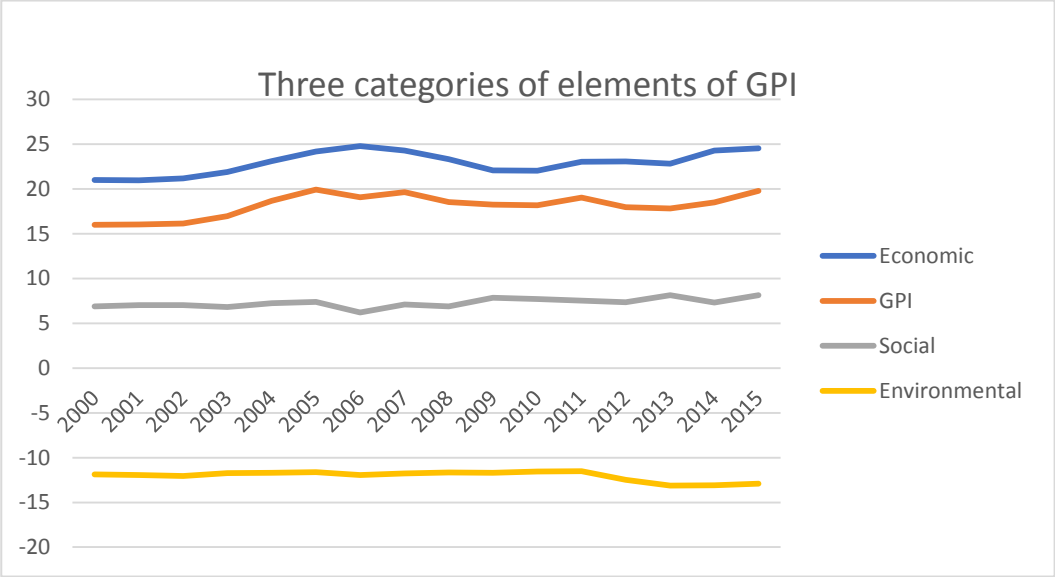

Figure 2: The three elements of GPI, and GPI itself, in billions of constant year 2015 dollars

- **Some costs were down, some benefits were up.** GPI rose by $1.288 billion between 2014 and 2015, two and a half times the $0.5 billion increase in Vermonters' consumption expenditures. The additional gains came from reductions in some cost categories and gains in some benefit categories. Among the gains: Net Capital Investment rose considerably (see the next item). The deduction for the state's use of fossil fuels (Cost of Non-Renewable Energy Resource Depletion) went down by $200 million. The value of Domestic Production increased by $470 million. Vermonters enjoyed more leisure time, reducing the Cost of Lost Leisure time by $180 million.
- **Net Capital Investment up.** Vermont businesses increased their capital outlays in 2015, outpacing depreciation by a total of $1.1 billion. This represents a 13.1% increase over 2014. This metric has climbed steadily since the recession year of 2009, when Net Capital Investment was negative, though it still falls well short of its pre-recession peak of $12.3 billion in 2005.
- **The Cost of Unemployment down.** The year 2015 saw a 7.4% drop in the cost of un- and underemployment. The number of Vermonters out of work and looking for work

fell by 2,290. This, along with a drop in underemployment, led to a $49 million reduction in this cost charge.

- **Large losses to income inequality--and the losses are growing.** Some of the gains in the Economic Elements of the GPI were offset by the deduction for income inequality, which amounted to $6.418 billion, an increase of 5.4 % over the previous year. Consistent with a national trend, the state's Gini Coefficient--a measure of the inequality of income distribution--rose from .04406 to .04452.[4] The adjustment for income inequality is the largest debit item in the GPI accounts. Were Vermont to return to the income distribution of 1970--the base year used in state GPI studies--the GPI would rise by 32.8%, to $26.25 billion.

Environmental Elements of the GPI (summary)

In 2015, three of the nine environmental cost elements of the GPI indicator set increased; three remained level; and three decreased. Because they are cost items, reduction or at least stasis in these indicators is desirable. The total of Environmental Costs measured by GPI fell 1.4% or $180 million in 2015, yielding a total deduction of $12.92 billion charged against the GPI bottom line. Altogether environmental costs total 65.3% of GPI. Had these environmental costs been zero for the year, GPI would have been $32.69 billion, edging out Gross State Product at $30.35 billion.

Some environmental costs cumulate from year to year. For instance, the loss of economically valuable ecosystem services from the conversion of an acre of forest to another use imposes that loss not only in the year of the conversion but in all successive years. For this reason, year-to-year changes in Cost of Net Forest Cover Change do not reflect the size of the deduction taken in the GPI accounts.

- The environmental cost indicators showing positive change were:
    - Cost of Net Forest Cover Change
    - Cost of Ozone Depletion
    - Cost of Non-Renewable Energy Resource Depletion

  Together these developments raised the GPI bottom line by $246 million.

[4] The Gini Coefficient is a standard measure of inequality in income distribution. For more on this measure see the section on Income Inequality.

- The environmental cost indicators that rose were
    - Cost of Water Pollution
    - Cost of Noise Pollution
    - Cost of Climate Change

  These increases took an additional $90 million from the GPI compared to their values for 2014.

- The Cost of Non-Renewable Energy Resource Depletion is a cost charge for burning irreplaceable fossil fuels, and is priced at what it would currently cost to replace those fossil fuels with renewable alternatives. This figure fell by $201 million dollars, a 3.7% drop, a result that is attributable to ongoing implementation of the state's Comprehensive Energy Plan and its call for getting 90% of the state's energy from renewables by 2050.
- Even with this notable progress, the Cost of Non-Renewable Energy Resource Depletion remains the second largest deduction in the GPI accounts behind the adjustment for Income Inequality. In 2015 this cost item totaled $5.2 billion, 26.31% of the GPI bottom line.
- This year's GPI compilation uses a new, more realistic figure for the value of clean water to Vermonters. This higher valuation has been "backcast" to previous years, to ensure comparability of the figure from 2000 to 2015. All told, Vermonters lost $2.10 billion of economic value to water pollution in 2015. This represents an increase of $8 million over 2014, a 0.4% increase. The cumulative figure for value lost to water pollution for 2005-2015 is $35.79 billion.

Social Elements of the GPI (summary)

This category of indicators includes both costs and benefits. The net contribution of this category to GPI's 2015 bottom line was positive: an $8.15 billion boost. This represents an 11.6% increase over the previous year's value of $7.31 billion. Among the largest changes here were the following:

- The Value of Domestic Production rose by 9.1%, as Vermonters reported spending more time in household activities that provide economic value, such as child- and elder-care, routine household maintenance, cooking, cleaning, etc. This indicator, one of the largest contributors to GPI at 28.12% of the total, added $5.56 billion to GPI's bottom line, and is one of two indicators responsible for most of the gains in the Social Elements category.

- The other significant gainer in this category was the Value of Higher Education, as the number of Vermonters with Bachelor's Degrees rose by 8,900, or two full percentage points, from 152,960 to 161,860. This change increased this indicator's contribution from $4.8 to $5.08 billion dollars between 2014 and 2015. Overall, this indicator accounted for 25.7% of the 2015 GPI.
- Vermonters gave up less leisure time in 2015 compared to 2014, reducing this cost item by $180 million (8.4% of 2014's $2.16 deduction).
- Other indicators in this section saw undesirable changes. The Cost of Commuting rose by 7.4%, or $65 million; the Cost of Motor Vehicle Crashes rose 6.6%, subtracting an additional $20 million from the bottom line (for a total deduction of $323 million). The Cost of Crime rose by 3.5%, becoming a $230 million deduction, equaling 1.2% of the GPI.

Conclusions and Recommendations

Over the last decade GSP grew by 8.7% while GPI declined by 0.9%. This suggests that in Vermont, as elsewhere, economic growth is accompanied by significant environmental, economic and social cost. Policy in pursuit of GPI-friendly (or at least GPI-neutral) growth would diminish the costs that GPI charges against GDP, and would tend to bring the two growth measures closer together. GPI-friendly economic development would include

- development of renewable energy sources;
- other economic development powered by those renewable energy sources;
- development (such as infill development within compact village and urban centers) that reduces in other ways the energy costs that Vermonters pay for fossil fuels, particularly for heating and transportation;
- Investment in conservation—reducing the throughput of energy and materials in the Vermont economy;
- development that does not add to the pollution burdens borne by the state's waters and air;
- development that does not reduce forestland, wetland or farmland;
- and most significantly, development that reduces income inequality within the state.

To be receiving data from 2015 at the start of 2018 may be less than optimally helpful. The authors of this report are aware that this time lag reduces the utility of the GPI as an instrument for helping set priorities and evaluating policies. We believe that the time lag could be reduced significantly through two developments:

One: Have relevant state agencies report necessary GPI data promptly and directly to the VT GPI Project in a form that is readily useful to the compilation. Current methods of data gathering are time consuming, and some data sources have large lags in their reporting times.

Two: Fund the VT GPI Project at a level appropriate to the work, so that professional staff can dedicate time and effort to the various tasks involved in completing an updated compilation, including collecting data as it is issued, implementing innovations in GPI methodology as appropriate, communicating and coordinating such methodological changes with GPI efforts in other states, and presenting the results in timely written and oral reports to legislators, members of the executive branch, the media and the general public. This years' and previous years' VT GPI work has largely been done on a pro-bono basis. This will not continue.

Improvements to GPI could be had through investment in staffing of the Project. Among the improvements that are needed is the implementation of the "GPI 2.0" methodology, as is now used by Maryland (see p. 72-3, below). Staff time and other resources are also needed to incorporate into the compilation such improvements as

- use of newly available Vermont-specific data to replace inferences drawn from national data;
- research into more recent, more precise valuations for environmental services;
- use of Geographic Information Services data to measure net change in biomes;
- development of Vermont-specific measurements for Time Use and Noise Pollution.

The utility of the GPI could be increased through three additional developments:

- linking GPI data to outcomes-based budgeting, as through program evaluation that uses GPI data on such social statistics as education levels, volunteer rates, crime rates and costs, public transit use, etc.
- creation of GPI notes, analogous to fiscal notes, to assess the impact of legislation on the various components of GPI;
- exploration of the possibility of compiling GPI at the level of the state's nine Act 250 districts, where it might be useful in the Act 250 process, given the possible interplay of GPI indicators and Act 250 criteria.

GDP may have been an appropriate indicator of overall economic wellbeing in the middle decades of last century, when the planet seemed vastly larger than the economy, when its resources seemed plentiful beyond counting, and its capacity to absorb our various effluents seemed infinite. GPI is the economic indicator we need now. While not an indicator of the *sustainable* economic wellbeing the economy creates, it is an indicator of the net wellbeing the economy creates and as such It is a key part of the conceptual toolkit Vermont needs as it continues to help lead the way to a new economy suited to the reality of a finite planet.

TABLE 2: Significant Data from the 2015 VT GPI. Dollar figures (except per-capita values) are in billions of 2015 dollars.

	2014	2015	% Change Since 2014	% Change Since 2005	% Share of GPI
GPI Adjustments					
Personal Consumption Expenditures	28.49	28.943	1.6%	11.36%	146%
Income Inequality Adjustment	6.15	6.48	5.4%	57.3%	-32.8%
Net Durable Goods Services	1.22	1.12	-7.85%	4.2%	5.7%
Cost of Underemployment	0.647	0.599	-7.4%	-1O.9%	-3.0%
Net Capital Investment	1.37	1.55	13.1%	-32.5%	7.9%
Cost of Water Pollution	2.09	2.10	0.4%	3.42%	10.62
Cost of Air Pollution	0	0	0.0%	-100.00%	-0.00%
Cost of Noise Pollution	0.15	0.16	2.1%	8.67%	-0.80%
Cost of Net Wetland Change	0.072	0.072	0.0%	-0.38%	-0.37%
Cost of Net Farmland Change	1.90	1.90	0.0%	0.11%	-9.61%
Cost of Net Forest Cover Change	0.86	0.83	-3.2%	63.39%	-4.20%
Cost of Climate Change	1.67	1.72	3.0%	17.67%	-8.71%
Cost of Ozone Depletion	0.95	0.93	-1.9%	-24.42%	-4.73%
Cost of Nonren. Energy Depletion	5.40	5.20	-3.7%	26.8%	-26.31%
Value of Household Labor	5.10	5.56	9.1%	5.97%	28.12%
Cost of Family Changes	0.18	0.17	-1.3%	-11.62%	-0.88%
Cost of Crime	0.22	0.23	3.5%	-11.1%	-1.17%
Cost of Personal Pollution Abatement	0.11	0.11	-1.6%	-7.68%	-0.54%
Value of Volunteer Work	0.385	0.383	-0.3%	-19.32%	1.94%
Cost of Lost Leisure Time	2.16	1.98	-8.4%	6.2%	-10%
Value of Higher Education	4.80	5.08	5.8%	24.75%	25.7%
Service Value of Highways and Streets	.873	.888	1.7%	30.21%	4.49%
Cost of Commuting	.881	.946	7.4%	20.58%	-4.78%
Cost of Motor Vehicle Crashes	.303	.323	6.6%	6.6%	-28.05%
Economic Elements Sub-Total	**24.28**	**24.54**	**1.05%**	**1.4%**	**124.1%**
Environmental Costs Sub-Total	**-13.10**	**-12.92**	**-1.40%**	**11.0%**	**-65.3%**
Social Cost/Benefits Sub-Total	**7.31**	**8.15**	**11.61%**	**10.4%**	**41.2%**
GPI Total	**18.485**	**19.773**	**7.0%**	**-0.9%**	**100%**
GSP Total	**29.729**	**30.355**	**2.12%**	**8.7%**	**133.75%**
VT Population	**626,984**	**626,088**	**-0.14%**	**1.1%**	
GPI per capita 2015 $	**29,483**	**31,5827**	**4.58%**	**-0.4%**	
GSP per capita 2015 $	**47,408**	**48,484**	**2.30%**	**7.8%**	

Chapter One:

The history and background of the Genuine Progress Indicator

The Origins of National Income Accounting

In the 1930s, during the depths of the Depression, policy makers had few statistical tools with which to grasp the enormity of the problem facing their management of the economy. One report has it that economists in Washington, D.C., charged with putting Americans back to work, were reduced to counting boxcars passing at railroad crossings in order to estimate changes in how much the productive capacity of the country was being put to use.

Figure 3 Simon Kuznets, chief architect of National Income Accounting and GDP, who warned against using the number as a measure of economic welfare

In response to the dearth of good information, the U.S. Department of Commerce commissioned Nobel laureate economist Simon Kuznets to lead a team in developing a set of national income accounts--numbers that would show how much of what was being produced within the economy. Their accounts included a powerful invention: Gross National Product, an estimated tally of the dollar value of all goods and services produced by Americans within a year. (GNP eventually gave way to GDP, Gross Domestic Product, as the decision was made to count production where it happened rather than based on the nationality of the workers producing it.) The first report based on the new national income accounts was issued to Congress in 1937.

There is no question that the new accounting system was a powerful tool for assisting policy. Reducing the disturbingly high unemployment rates of the Depression meant putting people back to work, and working people produce goods and services--the dollar value of which is exactly what GNP and later GDP were intended to measure. Economists Paul Samuelson and William Nordhaus have hailed the National Income and Product Accounts produced by Kuznets' team as "one of the great inventions of the twentieth century."[5]

Problems with GDP as a measure of economic wellbeing

Policymakers and economists alike have ignored the wise warning that Kuznets offered in his first report of the National Income Accounts to Congress: "the welfare of a nation can... scarcely be inferred from a measure of national income."[6] "Economic welfare," he cautioned, "cannot be adequately measured unless the personal distribution of income is known." Secondly, he said, "no income measurement undertakes to estimate the reverse side of income, that is, the intensity and unpleasantness of effort going into the earning of income." To generalize: economic benefits that are not generally shared can't be said to increase the general welfare, so our understanding of income figures must be adjusted to reflect distribution of that income. And there are costs as well as benefits to economic production; a measure of gain in economic welfare must necessarily be a net of the two.

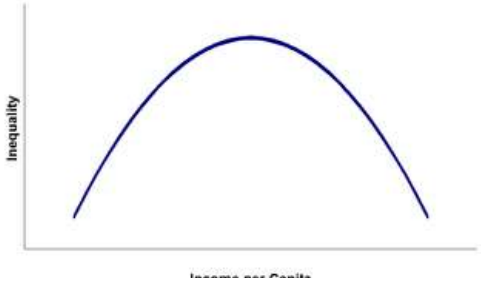

Figure 4: A conceptual model of the Kuznets Curve, showing a supposedly empirical relationship between national income as measured by GDP and inequality. This finding is controversial, and has not been discoverable in U.S. data from the past decade.

Absent any useful alternative, though, at first GNP and then GDP became, by default, the go-to measurement of the success of an economy. This mistaken reliance on valuing the sheer volume of commercial exchange is one strong root of the "growth mania" found in economic policy. Focus on GDP growth as the goal has led to other goals either being ignored, seen as subsidiary to growth, or being thought achievable only through additional growth. As this happened, devotion to growth as measured by GDP became a self-sealing world-view, supported by some evidence, incapable of being shaken by contrary evidence. Thus, concern about the increasing income inequality that

[5] Paul Samuelson and William Nordhaus, "GDP: One of the Great Inventions of the 20th Century," Bureau of Economic Analysis, *Survey of Current Business,* January 2000, accessed Jan. 22, 2018 from https://www.bea.gov/scb/account_articles/general/0100od/maintext.htm

[6] Simon Kuznets, 1934. "National Income, 1929–1932". 73rd US Congress, 2d session, Senate document no. 124, page 7. Accessed Jan. 22, 2018 from https://fraser.stlouisfed.org/scribd/?title_id=971&filepath=/files/docs/publications/natincome_1934/19340104_nationalinc.pdf

accompanied economic growth could be set aside, for economists (among them Simon Kuznets—the chief architect of the National Income Accounts) had found evidence of what became known as the Kuznets curve: as developing nations grew wealthier, income inequality at first increased but then decreased as the benefits of development became more widely shared. (See Figure 4.) Critics find that Kuznets' work did not fully account for the possibility that the decline in income inequality resulted from something else: once a nation achieved a certain level of development its income inequality could in effect be exported to less developed nations, as resource extraction in those nations tends to enrich elites but bring smaller or dubious benefits to the majority of the population. In any event the relationship—which Kuznets once posited as "pure guesswork"—has not obtained in the years since 1970, which have seen increasing concentrations of wealth in the U.S. and globally.[7]

This didn't deter some environmental economists from proposing another defense of growth in the form of the Environmental Kuznets Curve, having the same upside-down "u" shape as the Kuznets Curve, and purporting to model a similar effect with pollution: steadily increasing pollution was seen in the early years of an economy's development but was found by some studies to decrease later. The explanation that EKC partisans offered: as consumers grew wealthier they began to use their higher incomes to pay for reduction of pollution, in effect "buying back" environmental quality. The EKC suffers from some of the same basic flaws as the Kuznets Curve. EKC studies readily find such a relationship in many national economies but neglect to fully control for other explanations, including the phenomenon of pollution substitution, as industries develop processes that reduce emissions of indexed pollutants while increasing other pollutants not indexed by the E.P.A. Also left out of most EKC methodology is the possibility that dirty economic processes are off-loaded to other, less-developed economies. One critical review of the EKC literature found that the only studies supporting the curve's existence were studies that purposely set out to find it, and which manipulated or ignored data in their effort to get a "clean" EKC curve with a discoverable high point.[8]

In addition to these empirical difficulties there are conceptual difficulties with the EKC that are difficult to surmount. There is, of course, no way to "buy back" a species from extinction, so there is no way to buy the degree of environmental quality that obtained before that species went extinct. The logic behind the EKC leads to other absurd conclusions. The EKC tells us that the best path to reducing the deleterious effects of economic growth is more economic growth. It tells us that if climate change persists as a problem it is because the richest societies that have ever existed on the face of the planet are somehow not yet rich enough to choose to do something about it.

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[7] See Emmanuel Saez, "Income and Wealth Inequality: Evidence and Policy Implications," *Contemporary Economic Policy* 35, no. 1, Jan. 2017, 7-25.

[8] David I. Stern, "The Rise and Fall of the Environmental Kuznets Curve," *World Development* 32, no. 8, (2004) pp. 1419-1439. Stern goes on to suggest that the actual shape of the EKC is most probably an "N" shape: at first pollution rises with income, as economic processes dump effluents comparatively freely; but then the gross amount of pollution hits a peak as pollution controls are legislated and enforced; and after a brief fall, the underlying physical relationship between matter and energy throughput and inescapable output of effluents reasserts itself and the amount of pollution increases with additional economic growth.

In this "growth above all" world-view, human health, engaged citizens, meaningful lives and safe communities are all thought to depend on increasing GDP. They are not seen to be in and of themselves the foundations of economic life but are thought to be the result of it. This means that rather than treating the economy as the servant of society and its purposes, the growth paradigm instead treats society and its qualities as a subset of the economy and its values. This reversal of the proper order of things (which would be an conomy functioning within a society functioning within an environment) is one strong contributor to the troubling historical dynamic by which human and social values have been replaced by market-based economic values. That dynamic is seen in phenomena as diverse as the commodification of sexuality and other expressions of human nature; the reduction of citizenship to simple consumerism, as when Americans were exhorted to “keep shopping!” in the wake of the horror of 9-11; and the displacement of the natural human tendency to provide mutual aid and to be generous to neighbors by the economic rationalism of a “what will you do for me?” exchange-based social system in which we are not so much neighbors and fellow citizens but disconnected, self-seeking individuals who use each other to achieve our ends.

In the decades after World War II, as rebuilding economies became a top priority and before resource constraints and pollution became matters of general concern, the devotion to growth in GDP had few critics. Among them, though, was again counted Simon Kuznets, who issued another caution:

> Distinctions must be kept in mind between quantity and quality of growth, between costs and returns, and between the short and long run. Goals for more growth should specify more growth of what and for what.

Still, policy makers world-wide, and the economists who advise them, continue to celebrate increases in GDP no matter their cause and, conversely, to bemoan declines in that figure. While decreases in GDP can be economically troublesome, even devastating, since they usually correlate with declining employment and therefore with undesirable social and financial dislocation, increases in GDP are by no means automatically desirable, as shown by a mistaken bit of economic thinking called the Broken Window Fallacy.
First articulated by economist Frederic Bastiat in 1850, the fallacy is evident in a scenario he offered. Repair of a shopkeeper's broken window, Bastiat wrote, leads to an increase in the

Figure 5: Route 4 near Killington after Tropical Storm Irene. Repairing storm damage may have increased Gross State Product, but did not constitute a positive contribution to our wellbeing.

glazier's trade, and that seems a good thing, for it puts people to work and money into circulation. It would seem, then, that a glazier who sends an apprentice out into the night to break windows is doing the community an economic service. But that's absurd; as Bastiat went on to argue, the uptick in the glazier's trade is evident but what is difficult to see is the opportunity cost of the expense of repair. Invisible though it might be, that cost is very much a real burden on the community.[9]

Generalizing from there: remedial and defensive expenditures do not contribute to the advancement of our economic wellbeing, but seek to preserve or restore a level of wellbeing we've already attained. They draw expenditure away from the pursuit of goods and services that would make a net increase to our material wellbeing. Though identified more than a century and a half ago, the Broken Window fallacy is still very much with us today, as prominent policy makers –and even some economists-- have pointed to "silver linings" in such catastrophes as Tropical Storm Irene, taking note of the impetus the expenditures on repair would give to the state economy.[10]

This simple error is the result of the confusion of gross with net, and is deeply encoded into any use of GDP (or its state equivalent, Gross State Product) as a measure of material well-being. GDP is an estimate of the amount of monetary exchange that has taken place in the economy and as such it makes no distinction between remedial and defensive expenditure and money spent on benefits. Nor does it count opportunity costs of economic activity, notably the time not spent with family, among fellow citizens, or in leisure.

Thirty years after Kuznets's team gave their first report of national income, then-Senator Robert Kennedy gave a stirring account of the shortcomings of GDP when used as a measure of national well-being:

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[9] Bastiat, F. "That which is seen, and that which is not seen." Cited in Hazlitt, H.(1946). *Economics in one lesson: The shortest and surest way to understand basic economics*. (1850).

[10] See for instance Peter Hirschfeld, "Boost or Bust? Jobs Lost and gained in Irene's wake," Barre *Times Argus,* Sept. 13, 2011. The question as to whether a state economy benefits from disaster relief expenditure is a complicated one. See Appendix Three for a discussion of the conditions under which disaster-relief money may provide some small net gain to a state economy.

"Our Gross National Product … counts air pollution and cigarette advertising, and ambulances to clear our highways of carnage. It counts special locks for our doors and the jails for the people who break them. It counts the destruction of the redwood and the loss of our natural wonder in chaotic sprawl. It counts napalm and counts nuclear warheads and armored cars for the police to fight the riots in our cities. It counts Whitman's rifle and Speck's knife, and the television programs which glorify violence in order to sell toys to our children. Yet the gross national product does not allow for the health of our children, the quality of their education or the joy of their play. It does not include the beauty of our poetry or the strength of our marriages, the intelligence of our public debate or the integrity of our public officials. It measures neither our wit nor our courage, neither our wisdom nor our learning, neither our compassion nor our devotion to our country. It measures everything, in short, except that which makes life worthwhile."

Alternatives to GDP as a measure of economic wellbeing

Research on alternatives to GDP began in earnest in the 1970s and 80s. One strong avenue of development was the effort to create a series of monetized adjustments to GDP that would transform GDP's *gross* measure into a measure of *net* benefit created. In particular, the work of economists William Nordhaus and James Tobin (1972) on the Measure of Economic Welfare (MEW) provided the foundations to later development by Herman Daly and John Cobb (1989) of the Index of Sustainable Economic Welfare (ISEW). These approaches attached dollar values to costs and benefits that are ignored by GDP. The ISEW aimed particularly to arrive at accurate estimates of environmental externalities, subtracting them from the bottom line in order to arrive at an estimate of net sustainable economic wellbeing. The ISEW was later subsumed into a more standardized measure, now called the Genuine Progress Indicator, or GPI (Cobb et al. 1995). The GPI and ISEW have since been estimated and refined in over 20 countries (Kubiszewski et al. 2013), including a series of national estimates for the U.S. (Cobb et al. 1995; Anielski and Rowe 1999; Talberth et al. 2007), and a significant literature has developed that is advancing both the theory of the GPI and its application to policy (e.g. Neumayer 2000; Lawn 2003; Lawn 2005;

Clarke and Lawn 2008; Bagstad et al. 2014; Talberth 2014; Costanza et al. 2016; Barrington-Leigh and Escande, 2018).

TABLE 3: Comparison of Features of Traditional and Ecological Economics

	Traditional Economics	Ecological Economics
Definition of Progress	• Growth, understood as increased consumption of resources • More is always better	• Increasing quality of life • Preservation of natural capital • Satisfaction of human needs • Economic processes are sustainable, i.e. do not destroy their pre-conditions for existence
Underlying assumptions	• Resources are in effect unlimited because human ingenuity knows no bounds • Resources, capital and labor are mutually interchangeable, i.e. human invention can substitute for resources	• The planet is finite • The economy relies on planetary source and sink services • Human ingenuity will never allow us to violate physical law
Goal	• efficient allocation of resources to maximize satisfaction of consumer demand • Growth in resource throughput to maximize satisfaction of consumer demand	• Sustainable scale for the economy to ensure other goals can be met in perpetuity • Fair distribution of resources--both within and between generations • Efficient allocation of resources to maximize satisfaction of consumer demand and to meet human needs
Method of Measurement	Gross Domestic Product	Genuine Progress Indicator

After Table 1 in Chris Stiffler, "Colorado's Genuine Progress Indicator," Colorado Fiscal Institute, 2014, p. 18, at http://www.coloradofiscal.org/wp-content/uploads/2014/01/GPI-Final-Paper.pdf

Provocatively, GPI is both an extension of traditional double-entry bookkeeping to the economy as a whole and a key element of an emerging paradigm in Economics that seeks fundamental reform in the assumptions and purposes of the discipline (see Table 3). That it can play this

double role--logical extension and yet paradigm disruptor--is a result of GDP's complete unsuitability as a measure of economic welfare and the discipline's having ignored both logic and authoritative caution in adopting GDP as its primary measure of progress.

State GPI accounting--Vermont leadership and contribution

The first state-level GPI in the US was published for Vermont in 2004 (Costanza et al.), which laid the groundwork for other published studies in Maryland (McGuire et al. 2011), Ohio (Bagstad and Shammin 2012), Utah (Berik et al. 2011), and Northern Forest counties (Bagstad and Ceroni 2008). At the University of Vermont in December of 2011 a version of the Vermont GPI (Zencey et al., 2011) was presented to an audience including state legislators, leading to legislation passed in May 2012 commissioning the Gund Institute for Ecological Economics to continue to compile the state GPI for legislative and administration use. That month also saw a national conference on "Measuring What Matters" convened at the University of Vermont by the Gund Institute and Gross National Happiness USA;GPI work at the Gund was a central topic of discussion. A June 2013 "GPI in the States" summit organized by Demos and convened in Baltimore by the Governor of Maryland brought together 18 states with GPI accounts in place, under development or under consideration. Through collaboration between GPI researchers in Maryland and Vermont, a standard methodology for state GPI compilations evolved in 2012-2013 and came to be called "The Maryland-Vermont Model." Succeeding state compilations have drifted away from consistency with that model, as for instance GPI compilers in Hawai'i include metrics on "near and off-shore marine environments" and other states include metrics for biomes (like desert scrub) that aren't included in the MD-VT version and for other components of economic wellbeing like water security. Some state compilations make other, larger departures from the MD-VT Model. A one-year, 50-state compilation (Fox and Erickson, 2018) was completed at the Gund Institute for Ecological Economics in 2016, using a consistent methodology for each state, and until the data become fully stale-dated they can provide baseline metrics for useful comparison between states.[11]

The GPI is finding increasing use as a metric guiding development in historically underdeveloped areas, as evidenced by its endorsement by PAES, the Partnership for African Sustainability. Some policy makers in China are interested in adopting the indicator set, having diagnosed their

[11] Mairi-Jane Fox and Jon Erickson, "Genuine Economic Progress in the United States: A Fifty State Study and Comparative Assessment," *Ecological Economics* 147: 29-35, May 2018.

country's increasingly dire environmental issues as being the result of a mistaken emphasis on raising GDP no matter the cost.[12] (Children in secondary school in China were taught the main policy implication of the Environmental Kuznets Curve: environmental degradation is the price of progress and it can be corrected when incomes rise.[13])

In 2014 the Gund Institute convened a working conference of compilers of state GPIs and other interested parties. More than 80 people attended, representing nearly two dozen states. One outcome of the conference was new thinking about the methodology for state compilations, as represented by an article published in 2017 by conference attendees John Talberth and Michael Weisdorf.[14,15] The paper was a demonstration of changes in GPI methodology that had been discussed at the conference. Maryland has moved to institutionalize the methodological changes called for in the Talberth and Weisdorf paper. The authorizing legislation for the Vermont GPI directs that its compilation should parallel Maryland's, but staffing limitations have kept those proposed changes from being adopted for the current report.

In the absence of regular inter-state meetings to discuss and achieve consensus on GPI compilation methods, and as selected parts of the new methodologies of GPI 2.0 diffuse through the community of GPI practice, comparability of states' indicators will suffer. Vermont, once a leader in GPI studies, is now in the position of working to adopt methodological innovations articulated and piloted elsewhere.

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[12] Personal conversation, Eric Zencey and Chenghua Guan, Dean of the School of Economics and Business, Beijing Normal University, July 2015. See also Zencey, "China's Infinite-Growth Haze," *The Daly News,* April 9, 2013, at http://www.steadystate.org/chinas-infinite-growth-haze/

[13] Personal conversation, Eric Zencey and Wei Liu, graduate student in the Program in Sustainable Urbanism at the Sam Fox School of Design and Visual Art, Washington University in St. Louis, February 2018.

[14]For a brief history of the GPI in the states movement and the evolution of GPI methodology, see Mairi-Jane Venesky Fox, "Designing for Economic Success: A 50-State Analysis of the Genuine Progress Indicator," 2017 Ph.D. dissertation, University of Vermont, accessible at https://scholarworks.uvm.edu/cgi/viewcontent.cgi?referer=https://www.google.com/&httpsredir=1&article=1678&context=graddis

[15] John Talberth and Michael Weisdorf, "Genuine Progress Indicator 2.0: Pilot Accounts for the U.S., Maryland, and City of Baltimore 2012-2014," *Ecological Economics* 142, December 2017, pp. 1-11.

Chapter Two

The Economic Foundation in the GPI

Economic Elements of the 2015 Vermont GPI

The economic elements of the Genuine Progress Indicator include the starting figure, Personal Consumption Expenditure, and a series of adjustments for income inequality, the net value of services of consumer durables, the cost of unemployment, and net capital investment. The graph for Economic elements shows the effects of the double-dip GDP recession that Vermont and the rest of the country experienced in the years 2008-2014. These economic elements of the GPI reached their recent (fifteen year) high in 2006 with a value of $24.80 billion.

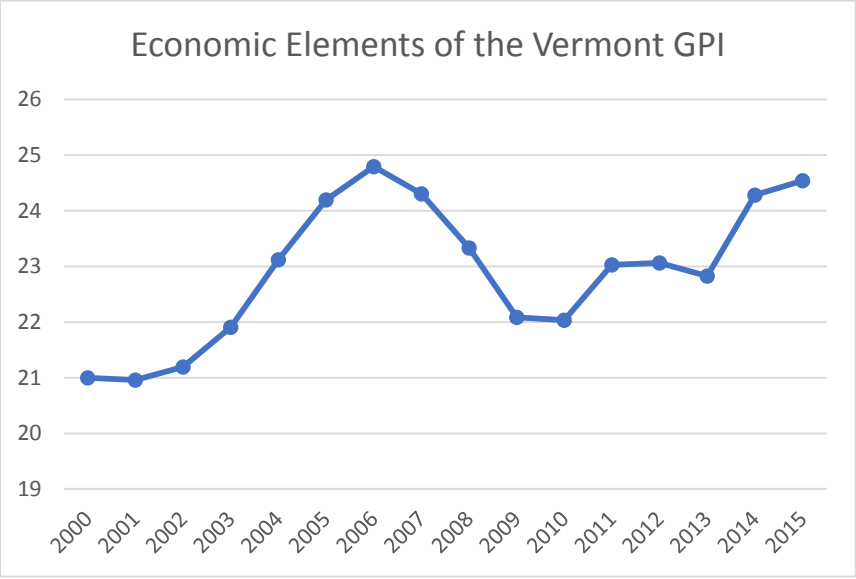

Figure 6: Economic Elements of the Vermont GPI, 2000-2015, in billions of year 2015 dollars

Another result of note: between 2006 and 2007, Net Capital Investment decreased and the Cost of Underemployment increased, indicating that Vermont firms were reducing their spending on capital equipment and Vermont workers were working fewer hours before the official start of the Great Recession in December of 2007. The two troughs in the Economic Elements came in 2010 and 2013, and took the total of this category to values of $22.04 billion and $22.83 billion, respectively. The gain from the 2013 figure to 2015's figure of $24.54 billion amounts to a 7.4% increase--a respectable two-year recovery.

1. Personal Consumption Expenditure

Personal Consumption Expenditure is the starting point for GPI compilations. This number, drawn from the Bureau of Economic Analysis's National Income and Product Accounts, is the primary measure of consumer spending on goods and services in the U.S. economy in a given time period. GPI begins with this figure as a way of accepting the premise that the purpose of the economy is to provide goods and services to consumers. For that reason, both government expenditures and business firms' expenditures are not included. While government spending can certainly contribute to citizens' quality of life, both immediately and in the future (especially through provision of *pure public goods,* goods that markets cannot produce efficiently or at all),[16] much government spending is already captured in PCE. The portion of government spending that isn't defensive and remedial

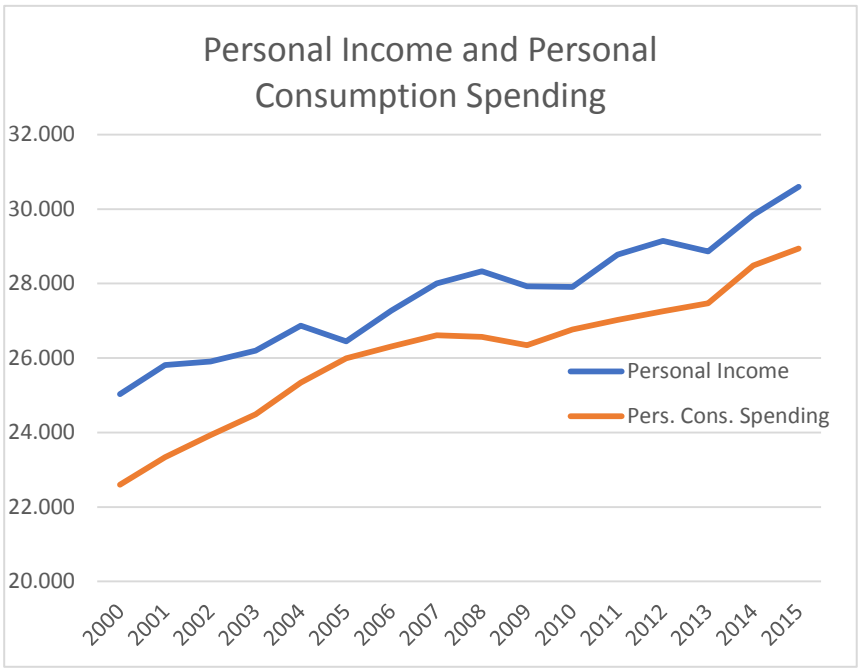

Figure7: Personal Consumption Expenditure and Personal Income, in billions of constant 2015 dollars

[16] Markets are efficient producers of goods that are both rival (my enjoyment of the good precludes your enjoyment of it, as with an automobile or a meal) and excludable (if you try to use my car I can call the police and stop you). Pure public goods, like lighthouses, streetlights, and national defense, are neither rival nor excludable: one person's use does not diminish the possibility of another's use, and no one can be denied the use of the good or service. Many goods are partially public goods, being either rival but not excludable (as, say, deer hunted on public land, fish caught from Lake Champlain) or excludable but not rival (musical performance, technical innovation, cable TV). Some goods are congestible (beaches, highways, wifi access); these can generally be made excludable (toll roads, my wifi connection) but we often choose not to do so (public roads, public beaches, public parks). Principles of economic efficiency require that pure public goods must be provided by public authority, for markets will under-produce them or not produce them at all. Efficient allocation dictates that partial public goods should be subsidized by public authority to produce an optimal allocation of resources to them.

is largely distributed in the form of transfer payments, contract payments, wages and salary. Expenditure by firms and corporations is also excluded for similar reasons: salaries, wages, dividends, interest and rent all show up as increases in someone's personal income with attendant effects on Personal Consumption Expenditure.

As Fig. 7 shows, Personal Consumption Expenditure in Vermont has trended upward over the 15-year period reviewed in this report, with one downturn during the Great Recession of 2008. While both Personal Consumption Expenditure and Personal Income have trended upward, the two values are not intimately linked; PCE does not always move with changes in Personal Income. This may be a sign that for many Vermonters, those categories of expenditure that tend to be relatively fixed in the short term--expenses like mortgage or rent, heat, other utilities, groceries--constitute a large portion of their consumer expenditure, and cannot be reduced when income declines. Additional research and analysis might better illuminate the relationships here.

2. Income Inequality

The GPI makes an adjustment to Personal Consumption Expenditure to reflect the degree of income inequality produced by the economy. Because the GPI aims to measure the general level of genuine economic well-being, it has to take into account how widely the material benefits of the economy are shared.

In 2015 Vermont's income inequality increased. As a result, the deduction for income inequality amounted to $6.48 billion, an increase of 5.4% over the previous year. In step with a national trend, the state's Gini Coefficient--a measure of the inequality of income distribution--rose from .04406 to .04452. The adjustment for income inequality is the largest debit item in the GPI accounts. Were Vermont to return to the income distribution of 1960--the base year used in state GPI studies--the GPI would rise by 37.4%, to $23.867 billion.

To make its adjustment to PCE, GPI methodology uses the Gini Coefficient. This number, which always is a value between zero and one, is derived from a simple formula that can be best understood visually. In Figure 8, the Lorenz Curve illustrates the degree of inequality in the distribution of income by showing what percentage of the population (given on the x axis) receives what percentage of total income (given on the y axis). A perfectly equal distribution of income would be a 45 degree line: 20% of the income goes to 20% of the population, 30% of income goes to 30%, and so on. Thus, the banana-shaped space between the 45 degree line and the actual distribution of income--the Lorenz Curve--is a ready measure of how much income inequality there is.

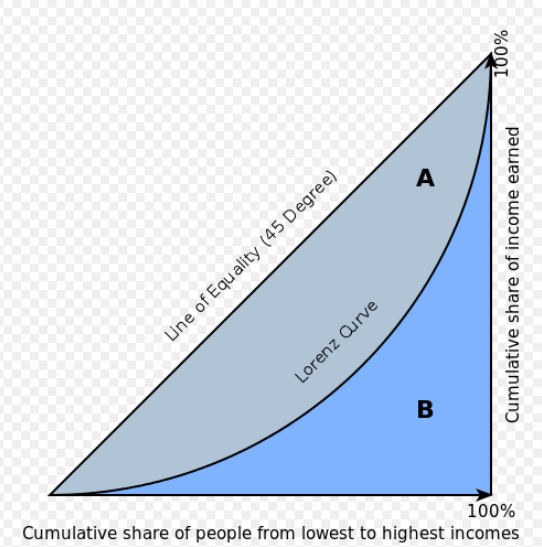

Figure 8: The Lorenz Curve illustrates the distribution of income within an economy

The Gini Coefficient is derived from the information illustrated in Figure 8. The formula is

$$\text{Gini} = A/A+B$$

As Fig. 9 shows, the state's Gini Coefficient shows some volatility. The two-year trend is up and the ten-year trend is up significantly. The value of the Gini Coefficient for 2016 is nearly equal to that of the 2013 peak of .4537. (This series extends back to 2006, the first year for which Vermont-specific values are available from the US Bureau of the Census.)

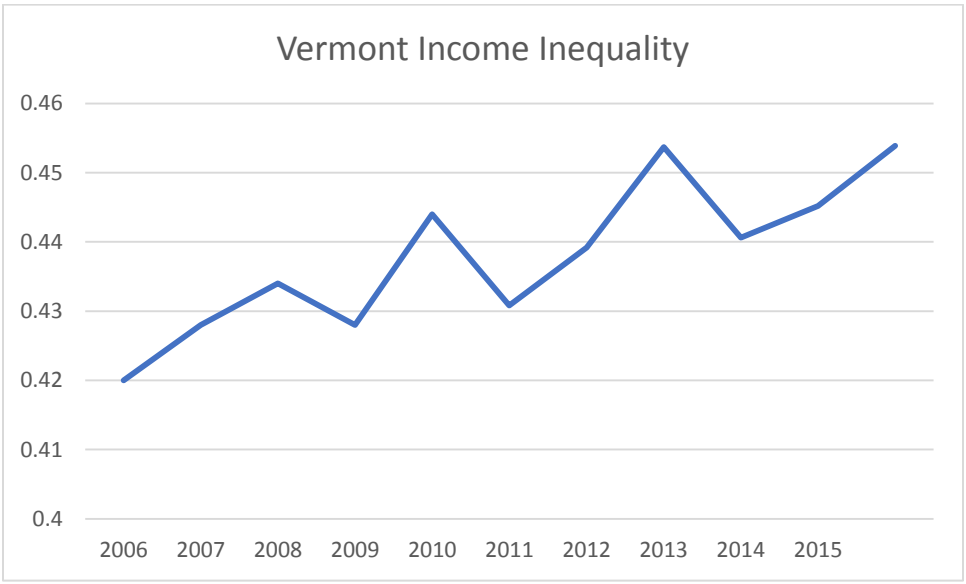

Figure 7: Vermont Income Inequality, 2000-2015, as scored by the state's Gini Coefficient. From Census Bureau data. See text for explanation.

In a study of income inequality in New England, researchers at the University of New Hampshire found that between 1989 and 2004, Vermont moved from 47th to 2nd in the "most income inequality" category among states. Only Connecticut had a higher Gini Coefficient in 2004. This movement toward greater inequality was national in scope, but the New England region was exceptional in moving from average levels of income inequality to containing the states with the most unequal distribution of income. Gittell and Rudokas report that New England had three of the five states with the largest increase in disparity in the period under study.[17]

Census Bureau data now allow for compilation of Gini Coefficients by state, county and zip code. An organization titled "Policy Map" has done that compilation, summing the data for the years 2012 to 2016, and has mapped the results, reporting Ginis in five tranches from 0.37 or less to 0.48 or more.[18] The Vermont GPI Project cannot vouch for the accuracy of their numbers, but if the compilation is accurate the patchwork result offers insight into patterns of income inequality in the state.

The statewide Gini, averaged from 2012 to 2016, was 0.44, lower than the US Gini of 0.48 for that period. Vermont counties with the highest Ginis in in the state, 0.46 to 0.47, were Windsor and Bennington. While no Vermont county registered in the highest tranch, 0.48 and higher, many counties contain individual zip code areas that registered in that category. Most of the rural areas of the state had Gini Coefficients of 0.37 or less. Montpelier's Gini was in the 0.41 to 0.43 range, while that of neighboring Barre was higher, climbing into the 0.44-0.47 range. Cities and resort areas are generally the loci of zip codes with the highest Gini ranges. Portions of Burlington, St. Albans, and Rutland score in the 0.48 and higher range. So too do Norwich; Woodstock; West Brattleboro; Plymouth; Weston; and zip codes associated with ski areas in Killington, Stowe, Ludlow, Stratton, Warren, and Westfield, VT.

At the level of zip codes or census tracts, a high level of income inequality may not be as problematic as it can be for the economy as a whole. At the local level, a higher Gini Coefficient can be associated with economic diversity, as would be the case if low-income housing were available in otherwise high-income areas. This diversity is often associated with better social outcomes for all residents, including better education, better health outcomes, lower risk of obesity[19] and better mental health.[20] Thus, care should be taken in interpreting Gini Coefficient data from small geographic areas; reference to additional information (as, for example, about those desired social outcomes) is indicated in order to obtain a clearer, more focused picture.

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[17] Ross Gittell and Jason Rudokas, "Change in Income Distribution in New England," Federal Reserve Bank of Boston, *Communities and Banking,* Fall 2007, pp. 20-23, accessed at

[18] Gini Coefficients for Vermont, Zip Code Tabulation, published by PolicyMap.org, accessed Feb. 20, 2018 at https://www.policymap.com/2017/07/gini-index-inequality-now-policymap/

[19] Jessie X. Fan, et al. "Tract- and County-Level Income Inequality and Individual Risk of Obesity in the United States," *Social Science Research* 2016 January; 55: 75-82.

[20] David Fone et al., "Common mental disorders, neighbourhood income inequality and income deprivation: small-area analysis, *The British Journal of Psychiatry* Apr 2013, 202 (4) 286-293; accessed at http://bjp.rcpsych.org/content/202/4/286

It is possible that mid-range income diversity registers as beneficial in its correlation with desired social outcomes while at some point higher levels of income diversity are detrimental to achieving those same goals. The literature on this topic is incomplete.

At the level of nations and societies, periods of high income inequality have been associated with political unrest. Prior to the French Revolution, economists estimate, income inequality in France had reached a Gini Coefficient of .59.[21]

The Gini Coefficient is an abstraction, but it registers an economic phenomenon that has concrete effects on ordinary Vermonters. According to survey research done through UVM's Center for Rural Studies, thirty-four percent of Vermonters report that they live from paycheck to paycheck most or all of the time; another 20% say that they live that way "sometimes." Thus, a total of 54% of Vermonters experience a significant degree of economic insecurity.[22] As one would expect, this insecurity has consequences. Ten percent of Vermonters report "overwhelming stress" regarding their personal finances while 50.6% report experiencing high or moderate stress from their personal financial situations. Thus, a large majority--60.6%--of Vermonters experience moderate-to-severe stress from their financial situation. Clearly, the Vermont economy is not working for everyone.

Figure 8: Vermont income inequality in 2015. Gini Coefficient values above 0.4 are widely thought to be undesirable

For the reasons given above, it's fair to say that Vermont's overall income inequality has entered into dangerous territory. Fig. 10 offers a graphic representation of this. The values of 0.2 and 0.6 used as "peg points" were not chosen arbitrarily. The lower peg lies just below the lowest current Gini measurement among nations of the world today; Finland ranks as the most income-egalitarian country with a Gini of .215.

High levels of income inequality are associated with a variety of unwanted socio-economic outcomes, including increased crime, poorer health for lower-income citizens, increased teen pregnancy, and loss of community and social cohesion.

The upper peg of 0.6 lies just above the Gini value of 0.59, which one pair of economic historians calculate was the Gini Coefficient of France on the verge of the French Revolution.[23] (It is not the highest recorded Gini Coefficient; the CIA's current World Fact Book

[21] Ian Morris, "To Each Age Its Inequality," NYT JULY 9, 2015 accessed at https://www.nytimes.com/2015/07/10/opinion/to-each-age-its-inequality.html?_r=0
[22] Folena De Gues and Michael Moser, *Vermont Happiness Study: 2017,* UVM Center for Rural Studies, p. 13.
[23] Christian Morrison and Wayne Snyder, "The Income Inequality of France in historical perspective," *European Review of Economic History,* 4 (2000), 59-83, p. 69.

reports an estimated Gini for Lesotho of 0.632, and it lists a total of five other countries--South Africa, the Central African Republic, Micronesia, Haiti and Botswana--whose Gini Coefficients edge over 0.60.)[24] Nor were the boundaries of the color-coded areas of the dial chosen arbitrarily. Economists are generally agreed that some income inequality is a stimulus to economic production, as productivity increases when effort is rewarded. Thus, the green color for values up to 0.30. A cautionary area leads up to the value of 0.40, a figure used by the World Bank and the UN as an alarm signal. According to the United Nations Research Institute for Social Development (UNRISD), above that value income inequality is associated with a variety of unwanted socio-economic outcomes, including increased crime, poorer health for lower-income citizens, increased teen pregnancy, and decay and subversion of democratic systems of government as political influence is wielded by the wealthy on their own behalf. Additional detrimental effects of income inequality in that upper range include loss of social cohesion necessary for governance and the migration of skilled labor to areas with less income inequality.[25]

While some political scientists and econometric historians have found a correlation between income inequality and the tenacity of civil wars within a country,[26] there is no clear line of demarcation beyond which a Gini measurement signals immanent social disruption. This is to say: different societies tolerate different levels of income inequality before becoming dysfunctional. How much income inequality Vermont could tolerate is not known. How much it *should* tolerate is a matter for political decision. Given the large deduction that income inequality takes from GPI (which Vermont has committed to raising), and given the correlation between rising income inequality and increases in numerous other phenomena that Vermont policy wisely seeks to reduce, strong policies to reduce income inequality would be one clear path to a higher GPI and other desired outcomes.

Bottom line: Continually rising economic inequality has a corrosive effect on the cohesion of Vermont society. That concern aside, a rising Gini signals a decline in the economic status of the state's most economically vulnerable citizens, which leads to greater demand for public services. Since the adjustment for income inequality is the largest single deduction in the GPI ledger, policies to decrease income inequality in Vermont would have strong and salutary effect on the GPI.

For additional material on income inequality, see Appendix One.

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[24]Central Intelligence Agency, "Country Comparison: Distribution of Family Income – Gini Index," *World Factbook,* accessed at https://www.cia.gov/library/publications/the-world-factbook/rankorder/2172rank.html

[25] UNRISD, "Inequalities and the Post-2015 Development Agenda: A Concept Note," Geneva, 2013. Accessed Jan. 15, 2018 at https://arxiv.org/ftp/arxiv/papers/1409/1409.3979.pdf

[26] Branko Milanovic, "The Inequality Possibility Frontier: Extensions and New Applications," Policy Research Working Paper 6449, The World Bank Development Research Group, Poverty and Inequality Team, May 2013. Accessed Jan. 14, 2018 from https://openknowledge.worldbank.org/bitstream/handle/10986/15589/WPS6449.pdf?sequence=1&isAllowed=y

3. Net Durable Goods Services

Many of the things that consumers buy are durable goods--goods that have a useful life of at least three years, like cars, major and minor appliances, furniture, and so on. GDP counts only the purchases consumers make in a given time period, so it doesn't capture the ongoing economic benefits of owning such durable goods. You buy a car in a particular year and as far as GDP is concerned in successive years that car has ceased to exist. What does show up in the GDP accounts are your expenses for fuel, oil, tires and so forth, but the car itself is something of a GDP ghost, its work and value unseen and uncounted. Not only that, but GDP gets the valuations exactly backward. When we buy a durable good what we want isn't to spend as much as possible, but to spend as little as possible to get the level of quality we seek. And what we want isn't so much possession of the good itself but enjoyment of the services the good provides: mechanized laundering from a washing machine, transportation from a car, floor covering from a rug. Getting the lowest price for a given quality of service value is the essence of economic rationality for an individual. Microeconomic theory is built upon the assumption that consumers behave this way. But at the larger, economy-wide scale, use of GDP as the basic measure of the economy's power to satisfy consumers implicitly supposes that spending more to get that service stream is desirable: all such expenditure raises the GDP.

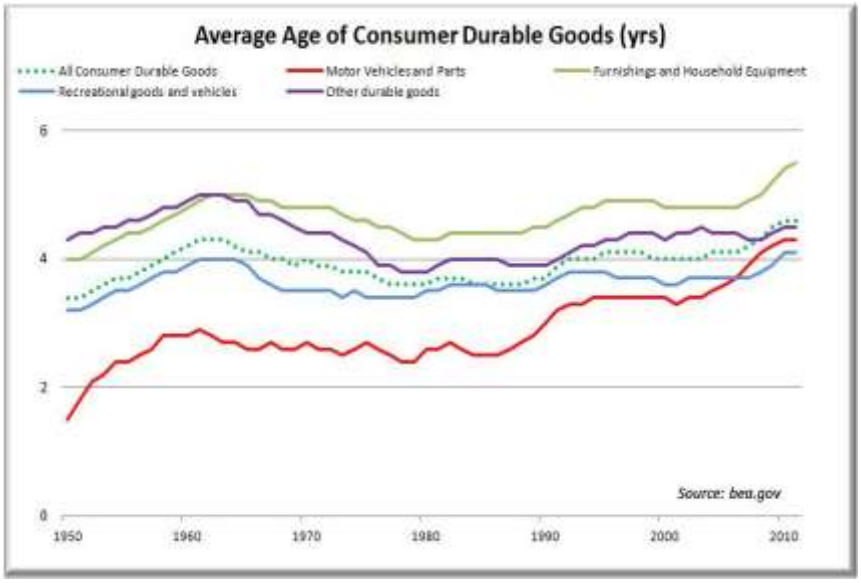

Figure 9: The average longevity of durable consumer goods in the U.S. has fluctuated around four years. Increased longevity would increase the GPI.

In contrast GPI takes a more rational approach to valuation of consumer durables by counting our expenditures on these goods as a cost item and counting the services we receive for our expenditure as a benefit. The net of these is what's measured here.

To accomplish this accounting, the GPI derives a figure for the value of the stock of consumer durables that citizens of Vermont own in any particular year and imputes a service value to that stock.[27] From that value is deducted the expenditure

[27] The average useful life of consumer durables, summed across all types, is thought to be seven years, so the average consumer has in any given year six years' worth of durables that are providing services at no cost.

Vermont consumers made that year on durable goods, as reported by the BEA. The result is Net Services of Consumer Durables.

Note that this approach discourages rather than encourages planned obsolescence and the churning of consumer purchases. If GDP is taken as the measure of our economic wellbeing, then repeated and frequent purchase-and-disposal of consumer durables is taken as a good thing. In contrast, GPI increases when and as consumers follow that old Vermont frugality slogan: "use it up, wear it out, make it do."

In 2015, Net Durable Goods Services fell by 8.2%, from $1.22 billion to $1.12 billion. This amount is 5.7% of the state GPI, a large enough portion to suggest that significant improvement here would have meaningful effect on the GPI bottom line.

As Figure 12 shows, the cost of consumer durables and the service value of consumer durables have an evident inverse relationship. The net service value of consumer durables held by Vermonters peaked in 2009; the value that year was $1.84 billion in 2015 dollars. Not coincidentally, that was also the recent (post 2000) year that Vermonters spent the least on durables. Given the deep recession into which the nation and the state fell in 2008, it makes sense that Vermonters postponed purchasing durable goods, increasing these goods' length of service and hence their net service value. The ongoing decline in this item from 2009 to 2015 is driven by steadily increasing expenditure on durables in that period. That increase may register, in part if not in whole, the release of demand held in abeyance by the decline in income during the Great Recession.

GPI takes the average of the current and the previous six years' worth of expenditure on consumer durables as the value of the yearly services provided by the existing and newly purchased stock of durables. The assumption is that we get what we pay for--no more, no less.

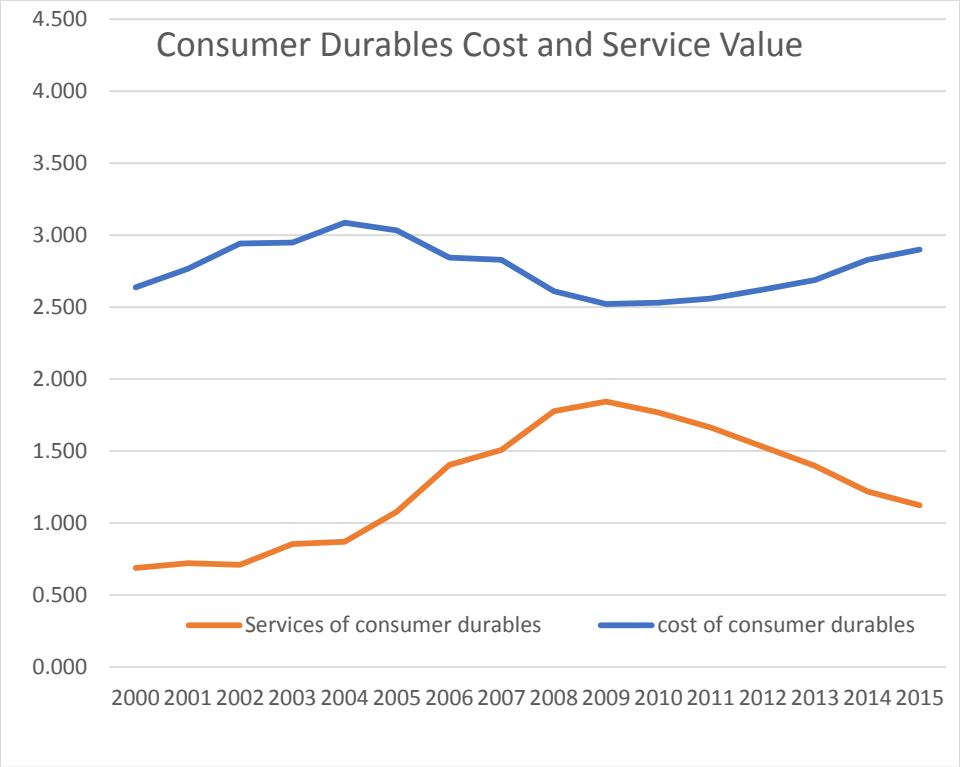

Figure 10: Expenditure on Consumer Durables and Net Service Value gained, in billions of year 2015 dollars.

This indicator could be honed by using actual Vermont-specific data instead of national and/or estimated data for the length of service life for various categories of consumer durables. For instance, the average service life of an automobile in Vermont might be different from the national average--and the actual service life might be derivable from data currently held by the Department of Motor Vehicles. Retailers and recyclers of consumer electronics and major appliances might be able to provide good data, or at least defensible estimates, on longevity of the items they handle. Here one can easily imagine the labor that would be saved by an embedded chip that would record and report the length of service life automatically to the recycler. As other states, especially populous ones that represent large markets, join in compiling state GPIs, the GPI movement may be able to exert pressure on manufacturers of durable goods to gather, or to provide the embedded technical means for gathering, such data.

4. Cost of Unemployment

Workers who are idled through unemployment, or who aren't working as much as they'd like to because employers can't take them on full-time, represent an economic loss to the community. GPI measures that loss and deducts it as a cost item. Though they are tracked separately, unemployment and underemployment are similar (unemployment being a severe case of underemployment). Both contribute to the cost that is registered here. The calculation is straightforward, and turns on the concept of "unprovided hours"--hours that workers would have worked if work had been available. (Workers who do not have unprovided hours are said to be "unconstrained.") Figures for unprovided hours are derived from state unemployment and underemployment figures given by the Bureau of Economic Analysis.[28] The number of unprovided hours in the state economy times the average hourly compensation rate yields the Cost of Underemployment.

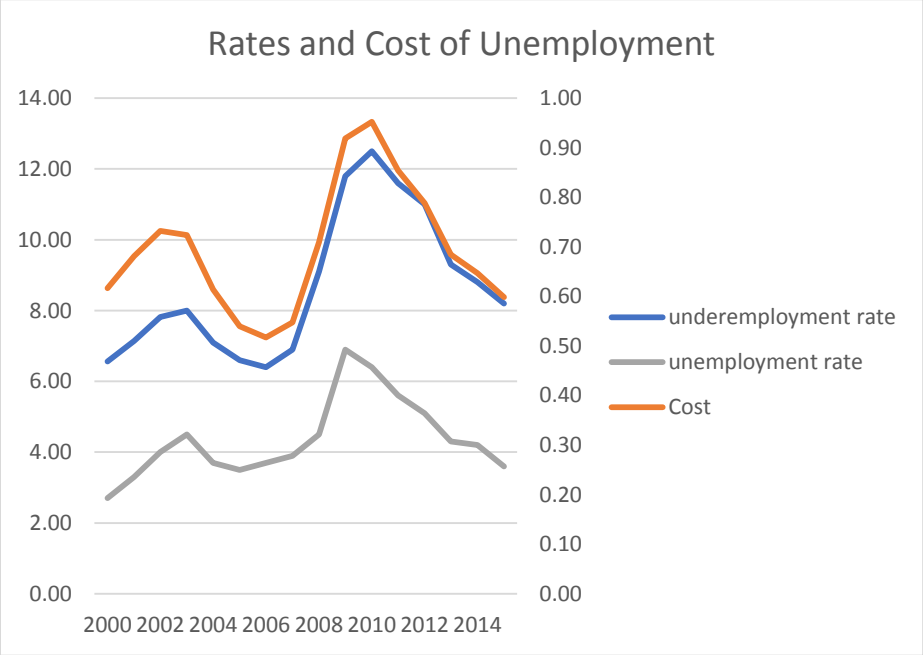

Figure 11: Rates and Cost of Un- and Underemployment. Rates are read from the values on the left hand axis and are given in percent of the workforce; cost, labelled on the right of the figure, is tallied in billions of 2015 dollars

The Cost of Underemployment went down in 2015, falling 5.3% from $440 million to $420 million in 2015 dollars. This charge represented 2.4% of the GPI.

As Figure 13 shows, the three measures--the unemployment rate, the under-employment Rate, and the Total Cost of Underemployment--closely track each other, which is not unexpected. The Underemployment Rate is considerably higher and slightly more volatile upwards, and less volatile downwards, than the unemployment rate, and it adds considerably to the overall cost tallied by this GPI indicator.

[28] The BEA keeps several different unemployment rates, U1 through U6. U3 is the official unemployment rate. U5 includes discouraged workers--those among the unemployed not actively seeking work. U6 adds in those workers who are limited to part-time strictly for economic reasons. The GPI compilation uses U6 in its estimate of underemployed workers.

The "double dip" recession that shows up in both GDP and GPI (though at slightly different times; see Figure 1) finds a parallel here in a "double peak" rise in unemployment--though the first peak, in 2003, does not correspond with a downturn in either GDP or GPI.

The Cost of Underemployment as registered by standard GPI methodology is the lost income that un- and underemployed people experience. This ignores several other kinds of costs that are very real--and very large.

Firstly, a long period of unemployment has been shown to have persistent downward effects on the unemployed person's future earnings; part of this can be explained through loss of "human capital" as skills and knowledge held by the unemployed person become outdated. This lost income not only depresses future Personal Consumption Expenditure by those people (and hence in the economy as a whole), it depresses tax revenues, limiting the ability of the public to purchase public goods (see note 14).

In addition, there are significant social costs of unemployment experienced by communities and psychic costs experienced by the un- and underemployed themselves. As far back as 1982 Liem and Rayman pointed out that prolonged unemployment is a serious threat to health and quality of life, and offered a review of research that finds correlations between the unemployment rate and such "indicators of strain" as psychiatric admissions, alcoholism and infant mortality.[29] This work by psychologists made little headway against economic orthodoxy which generally takes what Liem and Rayman characterize as a more "benign" view of unemployment (though this is changing with the gradual acceptance of "happiness studies" as a branch of Behavioral Economics). The more benign view is found in the work of economists who find functional value in the depressive effect that unemployment has on the ability of labor to advance wage and work-quality demands.[30]

Hollingsworth et al. (2017) find a strong link between unemployment rates and opioid abuse: "as the county unemployment rate increases by one percentage point, the opioid death rate per 100,000 [people] rises by ... 3.6% and the opioid overdose emergency department visit rate per 100,000 increases by 7.0%."[31] The authors didn't but could have pointed out that addiction to opioids tends to last long after economic conditions have improved enough to make re-employment feasible.

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[29] Ramsay Liem and Paula Rayman, "Health and social costs of unemployment: Research and policy considerations," *American Psychologist,* Vol. 37 (10), Oct. 1982, 1116-1123.

[30] Carl Shapiro and Joseph Stiglitz, "Equilibrium Unemployment as a Worker Discipline Device," *American Economic Review,* Vol. 74, No. 3 (June 1984), pp. 433-444, identify these effects but do not attach valuation to them. Conservative economists, however, are less shy about proposing that this effect has value. See for instance Bruce Bartlett, "Do Businesses Benefit from Unemployment?", *Fiscal Times,* Feb. 7, 2014, accessed Jan. 31, 2018 at http://www.thefiscaltimes.com/Columns/2014/02/07/Do-Businesses-Benefit-Unemployment

[31] Hollingsworth, Ruhm, and Simon, "Macroeconomic conditions and opioid abuse," NBER Working Paper No. 23192, revised March 2017, National Bureau of Economic Research, accessed 1.31.18 at http://www.nber.org/papers/w23192

The psychic costs of long-term unemployment are not always as dramatic as opioid addiction. They are denominated in the coin of ennervating depression; in lost hope, lost confidence and lost self-esteem; in withdrawal from the sort of social networks and contacts that, studies show, tend to keep a person healthy both psychically and physically.[32] Other significant costs of unemployment include upward pressure on crime rates and the loss of tax revenues to state and local governments. (We exclude the Federal government because that entity has the option to expand the money supply--to print money--to cover revenue losses, though it will often choose not to do so for ideological reasons.)

When the full range of costs are totaled the sum can be significant. A 2002 study reported from Britain estimates that the full cost of long-term unemployment amounts, on average, to a figure between $22,000 and $34,500 per month per unemployed person in year 2002 dollars.[33] This far exceeds the value of $2,544 per month (160 hours times the average hourly earnings of $15.90) that the current GPI methodology assigns as the cost for each unemployed Vermonter. This suggests that a realistic assessment of the costs of unemployment in Vermont would be--should be--considerably higher than that tallied by current GPI methodology. It should be kept in mind, though, that some minimum level of unemployment is considered structurally necessary to a dynamic, responsive economy, as workers shift jobs in response to price signals and as industries wax and wane with shifts in consumer demand.

5. Net Capital Investment

Capital--the tools that workers use to do their work--increases the productivity of labor. Capital equipment wears out. If a business doesn't replace worn capital, that business will die a more or less rapid death, depending on the depreciation rate of the particular kind of equipment common in that industry and what the firm's competitors are doing about their depreciating capital. And beyond simply replacing depreciated capital, positive investment in capital can lead to greater output per unit of input by increasing labor productivity and the efficiency of resource use. Additionally, if the workforce grows and the capital stock doesn't, the amount of capital per worker declines, leading to declines in productivity.

GPI measures Net Capital Investment in order to ascertain whether the economy is maintaining existing levels of capital per worker, increasing that investment or seeing that

[32] See Rebecca J. Rosen, "The Mental-Health Consequences of Unemployment," *The Atlantic,* June 8, 2014, accessed Jan. 31, 2018 from https://www.theatlantic.com/business/archive/2014/06/the-mental-health-consequences-of-unemployment/372449/

[33] Andrew E. Clark and Andrew J. Oswald, "A simple statistical method for measuring how life events affect happiness," *International Journal of Epidemiology* Vol. 31, Issue 6, December 2002, pages 1139-1144.

investment decrease through uncompensated depreciation.

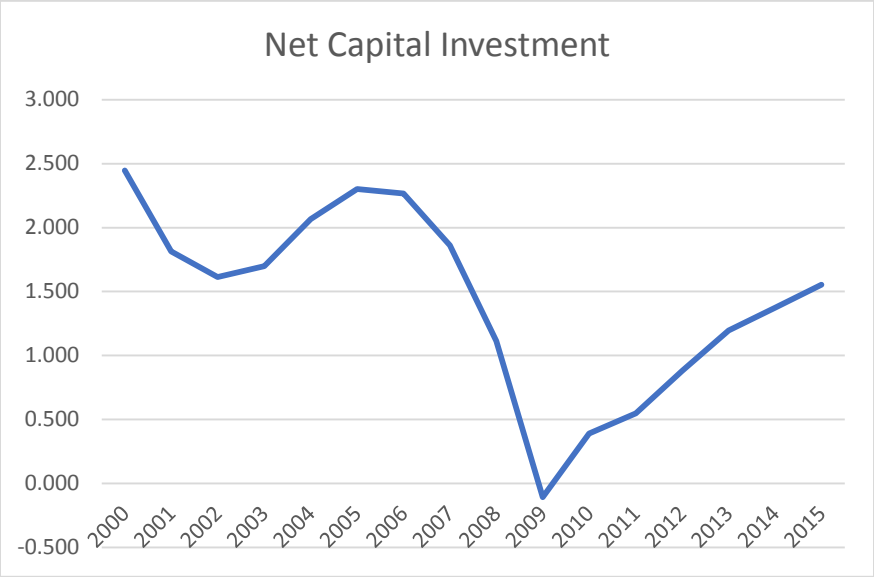

Figure 12: : Net Capital Investment in Vermont, 2000-2015, in billions of 2015 dollars, inferred from national data.

Unfortunately, there are no reliable figures for net capital investment by state. The standard work-around for GPI studies is to use a "step-down" from national data, prorating the dollar amount of national net capital investment on a per-capita basis. In 2015, the U.S. saw $561 billion in Private Domestic Investment net of depreciation. That yields a per capita figure of $1,748 which, when multiplied by the 2015 population of Vermont, gives the figure for Net Capital Investment used here. As Figure 14 shows, Vermont's Net Capital Investment as measured by this method has risen significantly from the negative value experienced in the depth of the 2008-2009 Great Recession, though it has not returned to the $1.72 billion figure seen in 2000.

Clearly, it would be good to have state-level data on Private Domestic Investment so that this contribution to the GPI could be made state-specific. As long as the GPI methodology has to resort to the work-around of a step-down from national data, no state policy can affect this GPI value one way or the other.

Chapter Three

The Environmental Costs of the Vermont Economy

Environmental Elements of the GPI

One of the improvements GPI makes over GDP is that it deducts environmental costs from the material benefits the economy produces. These costs include various kinds of pollution (water, air, noise) and the loss of ecosystem services from loss of various kinds of biomes (wetland, forest, farmland). The indicators here are built on two variables: one, an objective measure of the amount of the indicated phenomenon (acres of forest, percentage of waterbodies not meeting state-developed criteria for cleanliness) and a monetary value per unit of change. For wetlands, forest land and farmland the relevant monetary value is the ecosystem service value (ESV) of an acre of that kind of biome, as reported in peer-reviewed literature on ecosystem service values. For pollutants the monetary value is drawn from the relevant professional literature, which surveys health and quality-of-life costs for air, water and noise pollution. For other measures the valuation is constructed from relevant costs incurred or avoided. For instance, the Cost of Non-Renewable Energy Resource Depletion is compiled by totaling all the various kinds of non-renewable energy that were used in the state and assigning as the dollar valuation the current market price of an equivalent renewable resource--a gallon of biodiesel for a gallon of fossil fuel diesel, one kilowatt hour of renewably-sourced electricity for one kilowatt hour of non-renewably sourced electricity, and so on.

In total environmental costs of economic activity, Vermont does very well when compared to other states. It ranks seventh, behind three smaller states (Rhode Island, Delaware, New Hampshire), a state that has a tropical climate and so doesn't rely heavily on fossil fuel for winter heating (Hawai'i), and a state that has seven times the land area holding a similarly sized population (North Dakota). (The other state, Alaska, is a statistical oddity in the 50-state GPI compilation. It ranks first in lowest environmental costs by a wide margin because it scores a significant gain in wetlands valuation as its acreage of wetlands increases from year to year—a

change that is driven in part by climate change.) On a cost-per-capita basis, Vermont moves up in the standings, to fifth, behind Alaska (again), New Hampshire, Idaho, and New Mexico.[34]

In 2015, three of the nine environmental cost elements of the GPI indicator set increased; three remained level; and three decreased. Because they are cost items, reduction or at least stasis in these indicators is desirable. The total of Environmental Costs measured by GPI fell 1.4% or $180 million in 2015, yielding a total deduction of $12.92 billion charged against the GPI bottom line. Altogether environmental costs total 65.3% of GPI. Had these environmental costs been zero for the year, GPI would have been $32.69 billion, edging out Gross State Product at $30.35 billion.

A zero value for all environmental costs would be difficult to achieve, because some environmental costs cumulate from year to year and significant historical costs are carried forward into the present. This is done because the loss of economically valuable ecosystem services from (for example) the conversion of an acre of forest to another use imposes that loss not only in the year of the conversion but in all successive years. The carry-forward of such cumulative cost means that year-to-year changes in these indicators do not reflect the size of the deduction taken in the GPI accounts. To continue the example of Net Cost of Loss of Forest Cover: In 2015 Vermont added about 6000 acres of forest, with an ecosystem service value calculated to be $27.3 million. In the GPI accounts this sum was deducted from the ongoing cost of Vermont's loss of forestland, which totaled $857.7 million in 2014.

The GPI aims to be a measure of the net economic welfare produced by the economy. It is not a measure of the net *sustainable* economic welfare produced by the economy. Because Personal Consumption Expenditure is the foundation of the GPI calculation, and because the per-unit costs of pollution and environmental changes are set conservatively low, a rising GPI is possible even as the economy producing that GPI is unsustainable, i.e. it depletes the non-renewable resources on which it depends, or in other ways compromises, degrades or destroys its own preconditions for existence.[35] The challenge of deriving a set of sustainability indicators has occupied researchers for decades,[36] and compilation of a fully detailed set of sustainability indicators would represent a considerable investment in staff research time. There is, however, a relatively simple proxy measurement that is conceptually clear and justifiable within the framework of Ecological Economics, which sees the economy as a set of physical processes in

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[34] Fox and Erickson, "Genuine economic progress in the United States: a fifty state study and comparative assessment," *Ecological Economics* 147 (2018) 29-35; state rankings calculated by the authors of the present study from the Fox and Erickson spreadsheet.

[35] The definition of sustainable in use here was first proposed by Zencey (2012).

[36] See Simon Bells and Stephen Morse, eds., *Routledge Handbook of Sustainability Indicators* (Routledge/Taylor and Francis Group, 2018) for a review of three decades' worth of work on sustainability indicators and an analysis of the current state of the field. Also of interest is the report "Developing a New Approach for Measuring Regional Sustainability," in *Evidence Matters*, issued by the Office of Policy Development and Research, U.S. Department of Housing and Urban Development, Washington D.C., summer 2011, accessed at https://www.huduser.gov/portal/periodicals/em/summer11/highlight2_sidebar.html#h2sb2_1

which humans use energy to manipulate matter according to their purposes and while employing as much design intelligence as they can muster. Matter, energy and design intelligence are, in this view, the three factors of economic production, made visible by taking a different "slice" on economic activity than the perspective that sees labor and capital as the essential factors of production.[37] Given enough energy, the sheer physical matter that moves through the economy can, in theory, be fully recycled, but physical law forbids the recycling of energy. This physical limitation, and the central role that energy plays as a factor of production, suggest that an effective, first-approximation measure of the degree to which an economy approaches the condition of sustainability can be had from one relatively simple statistical measure: the percentage of energy used in the economy that comes from renewable sources. This proxy ignores other significant factors that also determine a whether an economy is sustainable or not: whether the economy exceeds the planet's capacity to provide sink services; whether the physical matter that moves through the economy is sourced sustainably; and whether the economy is productive of or at least consistent with social and political conditions that are sustainable. Still, the percentage of energy used in the economy that is renewably sourced is the single clearest dial on the sustainability dashboard.

For 2017, in Vermont, that percentage was 24.9%, placing Vermont eighth among all states and the District of Columbia.[38]

The three environmental indicators showing positive change were:

- Cost of Net Forest Cover Change
- Cost of Ozone Depletion
- Cost of Non-Renewable Energy Resource Depletion

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[37] The new view cuts across the old view at right angles. Thus, as a factor of production labor is discretionary Energy that has more or less room to exercise its native capacity to conceive and implement Design Intelligence; capital is equipment made out of physical Matter using Energy and embodying generations of accumulated Design Intelligence. Some forms of capital embody so much Design Intelligence that Labor's role requires little exercise of intelligence. Traditional economic theory treats Labor and capital as the sole factors of production. Robert Solow, who was awarded a Nobel Prize in Economics in part for his work on the production function, which parses the value added by each productive factor, once supposed that "if God had meant for there to be more than two factors of production, He would have made it easier for us to draw three-dimensional diagrams." Solow, "The Production Function and the Theory of Capital," *The Review of Economic Studies* 23:2, 1955-56, pp. 101-108, p. 101. Herman Daly has criticized the standard model for leaving out resources—matter and energy—entirely, saying that it thereby supposes that investment in capital and labor can always increase output, when in fact (and for instance) the forest products industry can't always increase output simply by adding chainsaws and chainsaw operators; the saws and operators will need a supply of trees to cut. See Quentin Coulx, "The role of Natural Resources in Production: Georgescu-Roegen/Daly versus Solow/Stiglitz," Documents du Travail du Centre d'Economie de la Sorbonne, 2018, accessed at https://halshs.archives-ouvertes.fr/halshs-01702401/

[38] U.S. Energy Information Administration, "Vermont: State Profile and Energy Estimates," accessed March 11, 2018, from https://www.eia.gov/state/data.php?sid=VT

Together these developments raised the GPI bottom line by $246 million.

The three environmental cost indicators that rose were:

- Cost of Water Pollution,
- Cost of Noise Pollution and
- Cost of Climate Change.

These increases took an additional $90 million from the GPI compared to their values for 2014.

Total Environmental Costs reached a recent (post 2000) low point in 2011, when the Cost of Non-Renewable Energy Resource Depletion reached its own post-2000 low point. Please see the section on that indicator, below, for more on that phenomenon.

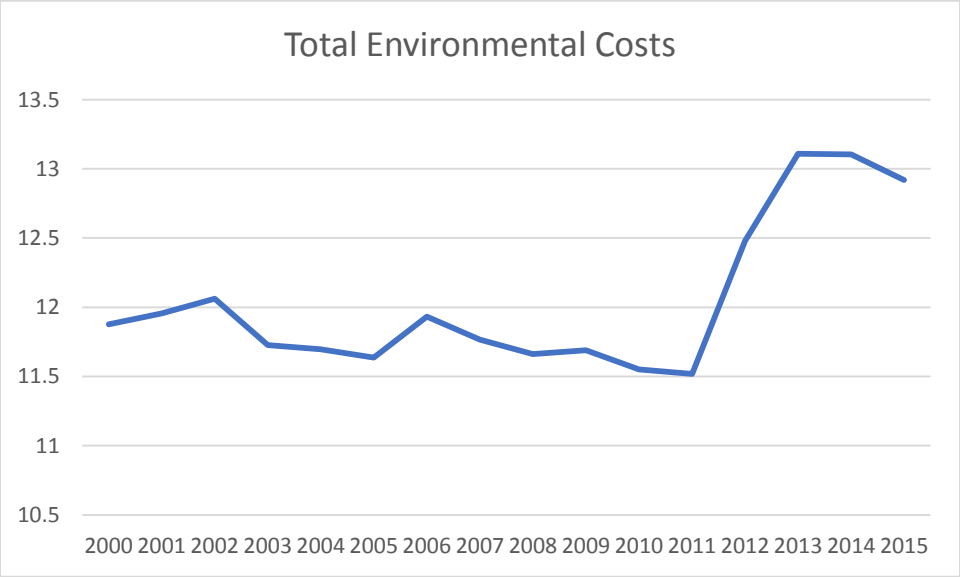

Figure 13: Total Environmental Costs, 2000-2015, in billions of year 2015 dollars

6. Cost of Water Pollution

This year's GPI compilation uses a new, more realistic figure for the value of clean water to Vermonters, increasing the Cost of Water Pollution significantly.[39] (The higher valuation has been "backcast" to previous years, to ensure comparability of the figure from 2000 to 2015.)

All told, Vermonters lost $2.1 billion of economic value to water pollution in 2015. This represents an increase of $8 million over 2014. While the Cost of Water Pollution is not cumulative in the way that some other costs in this category are, still, the Cost of Water Pollution can be totaled over a span of years. The cumulative figure for economic value lost to water pollution for 2005-2015 is $35.79 billion.

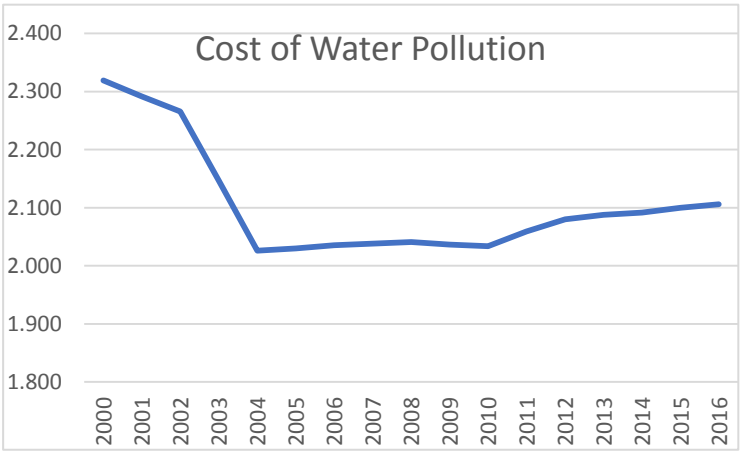

Figure 14: Cost to Vermonters of Water Pollution, in billions of 2015 dollars

7. Cost of Air Pollution

The cost of air pollution registered by standard GPI methodology was zero for 2015. The standard methodology measures the number of days in which ground-level ozone exceeded permissible standards, and Vermont had no "ozone exceedence days" in 2015 and 2014.

[39] An Appendix describes the new methodology and the rationale for adopting it.

This does not mean that there was no air pollution nor any cost from it in those years.

The standard GPI methodology traces to the work first done in Maryland, where ground-level ozone was considered to be the main pollution problem, and was done at a time when good state-level data for other index pollutants tracked by the E.P.A. was not readily available. For this reason, Maryland chose ground-level ozone to be a suitable proxy for other kinds of air pollution. The evolving methodology of the GPI--"GPI 2.0"--calls for including here the costs imposed by the other four major air pollutants that are regulated by the Clean Air Act: particulate matter, carbon monoxide, sulfur dioxide, and nitrogen dioxide. Data for all of these are available at the state level, and calculations of the health and other costs associated with different levels of these pollutants are available in the literature. Additional staff time would be needed to include this broader base of information and more accurate cost calculation in the Vermont GPI.

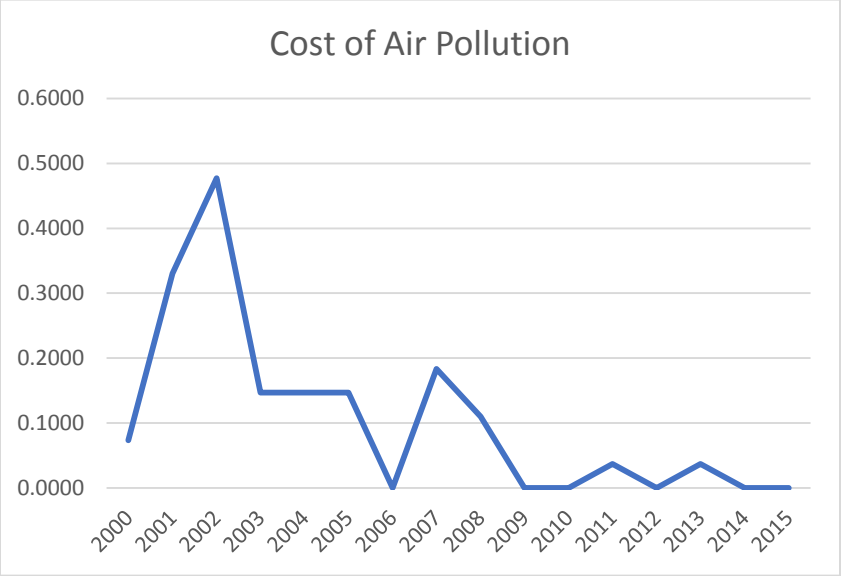

Figure 15: Cost of Air Pollution in billions of constant year 2015 dollars

8. Cost of Noise Pollution

Silence is a commons shared by all, degradable by any. That degradation is called noise pollution. Noise is any sound unwanted by one or more listeners, however purposely made by other humans. The hum of traffic; the leaf blower in a neighboring yard; the roar of an airplane takeoff; the chain saw across the valley on a still afternoon; the jet skis jumping waves within earshot of shore; the especially loud motorcycle and the neighbor's late-night party that interrupts sleep: these and other sources of noise pollution impose costs on Vermonters. Some of those costs are subjective; annoyance and disturbed tranquility lie in the ear of the

beholder and vary with mind set and context. But many of the costs of unwanted sound can be tabulated objectively by reference to the effects of noise on human health and wellbeing and the expenses we undertake to reduce our exposure to noise. The largest health and wellbeing effects of noise pollution come through sleep disturbance and environmentally induced stress. A burgeoning literature details those effects. They include impaired cognitive functioning; increased risk of cardiovascular disease; digestive problems; lost productivity; degraded mental health; and increased intolerance and aggressiveness toward others.[40]

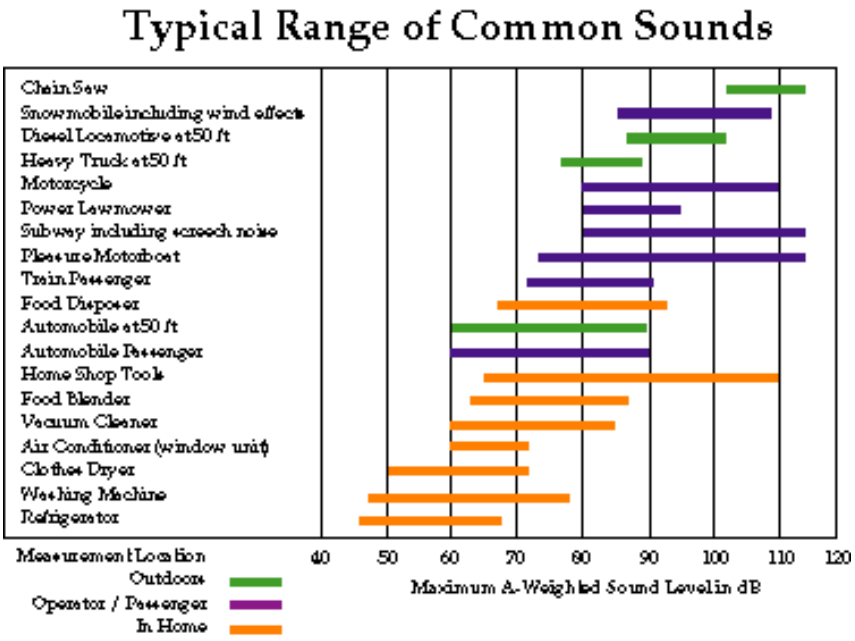

Figure 16: Typical dB ranges of common sounds, from EPA data

Nor are the costs of noise pollution borne exclusively by humans. Among its effects on animal populations, humanly generated noise can impair growth; prevent communication and spatial orientation; constrict habitat range; degrade the ability to find food; lead to energy losses though panic and escape behavior, thereby diminishing reproductive success; and (as in humans) increase the incidence of stress-induced illnesses. These zoological effects can impose direct economic costs on humans through loss of ecosystem services provided by the affected wildlife populations. For instance, if noise prevents bats from echolocating in an area, they will avoid it, thereby depriving that area of their check on insect proliferation.

There exists no good measure of the incidence of noise pollution in Vermont (or in any state for that matter). Following Maryland, previous state compilations have used an index of urbanization as a proxy for level of noise pollution, on the assumption that traffic is the largest single source of noise pollution and traffic noise is correlated with degree of urbanization. This methodology encourages Maryland to raise its GPI through the construction of noise-barrier walls along major highways that transect populated areas. (The effect on GPI is not automatic, but must come through adjustment of the coefficient describing the relationship between degree of urbanization and level of ambient traffic noise experienced by Marylanders.) This

[40] den Boer and Schroten, "Traffic Noise Reduction in Europe: Health effects, social costs and technical and policy options to reduce road and rail traffic noise," CE Delft, The Netherlands, August 2007; accessed at http://www.noiseineu.eu/en/2959-a/homeindex/file?objectid=2736&objecttypeid=0

proxy approach was used in previous Vermont GPI compilations, though the Vermont reports consistently noted that this methodological work-around was especially unsatisfactory for a predominantly rural state whose economy is tourism-dependent and therefore reliant in part on its reputation as a tranquil retreat from the hurly-burly of urban life. Vermont's noise pollution problems don't center on Interstate traffic bordering residential areas; the sources of noise pollution in Vermont are many and varied.

This report implements a different proxy approach to valuation of the cost of Vermont's noise pollution. The different proxy was recently used in a compilation of GPI for the State of Missouri[41] and is backed by research done in Europe. For the European Union member states, den Boer and Schroten (2007) surveyed the direct costs of noise pollution on humans (i.e., they excluded costs of noise pollution on wildlife) and pegged them at 0.52% of the EU's GDP. That number is used here. Obviously, since the resulting Cost of Noise Pollution is tied directly to Gross State Product, this approach provides no direct policy lever, no easy means by which GPI could be raised by reducing noise pollution directly. Under this methodology reducing GDP would be one way to reduce this cost item. Otherwise, as with the Maryland proxy, any GPI effect would have to come through laborious recalculation of a correlation: noise per unit of urbanization for Maryland, noise per unit of GSP for Vermont. While neither proxy is fully satisfactory, we believe that a number based on justifiable assumptions suited to our state is better than one based on justifiable assumptions suited to another state, and that it is certainly preferable to no number at all.

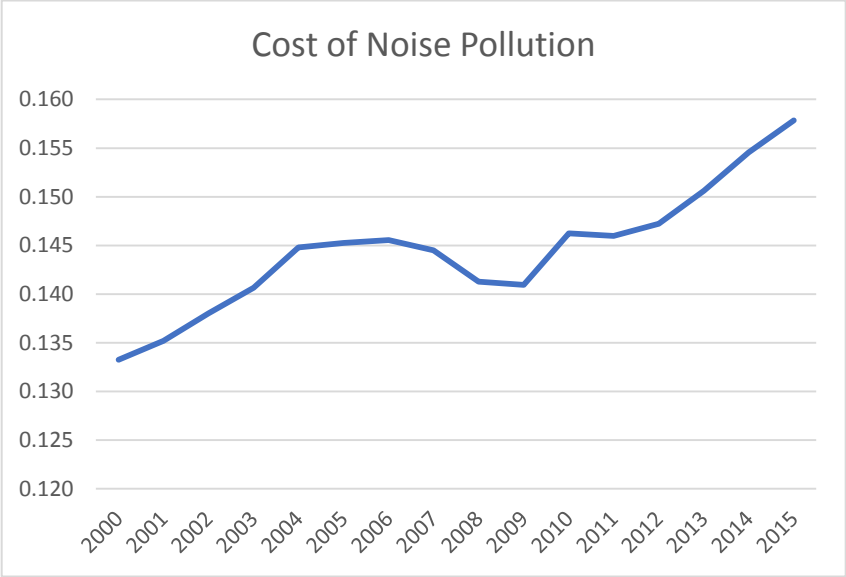

Figure 17: Cost of Noise Pollution, proxied as a percentage of GSP, in billions of 2015 dollars

Figure 19 shows the Cost of Noise Pollution as determined by this method.

[41] Eric Zencey, "The Genuine Economy of the Show-Me State: A Report on the Missouri Genuine Progress Indicator 2000-2014," prepared for the Missouri Coalition in the Environment, July 2016. Available from the author.

9. Cost of Net Wetlands Change

Wetlands provide a variety of economically valuable ecosystem services to Vermonters, and this indicator measures the cumulative value of their net change. A cost imposed by the loss of an acre in wetlands one year is carried on into the next (and next and next), as the cost is experienced not only in the year of the loss but in all succeeding years. By convention among GPI compilers, the assignment of such cost begins with European settlement.

As Figure 20 indicates, this cost has remained nearly flat over the decade and a half of this study, although the visual representation doesn't emphasize that there is a slight, steady increase in this cost from year to year. The annual increase is under a half million (year 2015) dollars in that fifteen year period, and has a minimal effect on the GPI.

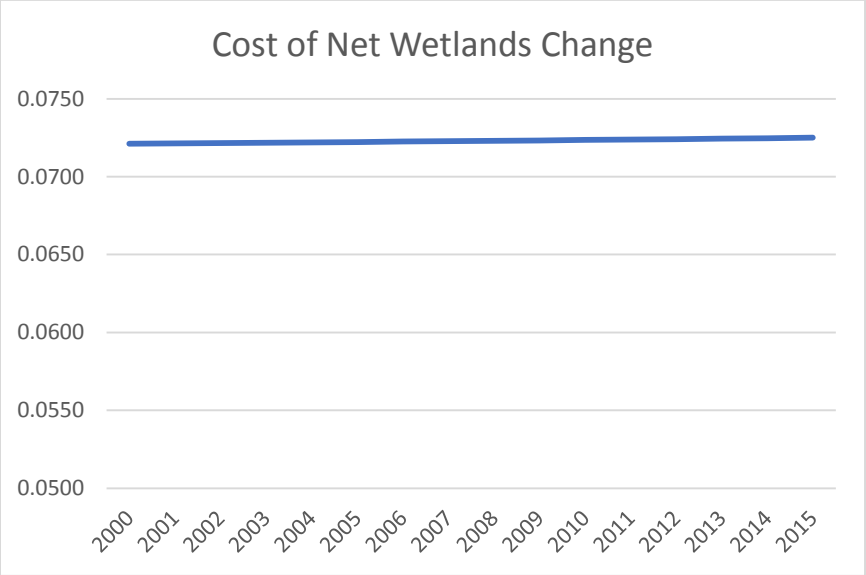

Figure 18: Cost of Net Wetlands Change, in billions of year 2015 dollars

The slight but steady increase in Cost of Net Wetlands Change is an artifact of the assumptions made about rates of wetland loss and their steady increase in valuation. If the assumptions are valid, then the figures here are valid approximations. One key assumption, grounded on expert opinion from officials in the Department of Environmental Conservation, is that since the passage of the Vermont Wetland Rules in 1990, the state has seen minimal net loss of wetlands, estimated to be just 3 acres per year. The Rules forbid net loss of wetlands from development and allow developers to substitute constructed wetlands for natural wetlands under certain conditions. The annual net loss of three acres reflects, in part, the reality that constructed wetlands do not provide the breadth and depth of ecosystem services that natural wetlands do.

As with other indicators measuring the ecosystem service value of different landscapes and biomes, the accuracy of this indicator could be improved by employing firm numbers on net change in wetland acreage obtained through use of Geographic Information Systems modelling

and existing satellite data. That work is not conceptually difficult but would require an investment in staff time and other resources.

The valuation of ecosystem services from wetlands is assumed to increase incrementally with each passing year, as wetlands become generally scarcer in the region and as the human population increases (since the main model for ecosystem valuation sees the total valuation as the unit valuation per person times the number of people). The absolute size of the cost reflects net loss of wetlands since the time of European settlement; the long-ago loss of ecosystem services from European settlement and population expansion is part of the carried cost of the present-day economy.

10. Cost of Net Farmland Change

Figure 19: The statue of Ceres, Greek goddess of agriculture, tops the Vermont statehouse

Well before Vermont became a state in 1791, agriculture was at the core of its culture, its heritage, and its economy. It has remained so ever since, though modern development has added two other broad sectors to Vermont's economy: manufacturing and tourism. Agriculture's continuing status as one of the three "legs" of the Vermont economic tripod is evident in even a simple recitation of data, such as these from 2016:

- the economic impact of agriculture that year was estimated to be $2.63 billion, or 8.5% of the state's GSP;
- the state had 12,000 farm laborers and operators, totaling 3.6% of the workforce, far above the national average of 1.5%;
- twenty-one percent of its land was in farming, compared to 8% for neighboring New Hampshire, 10% for Massachusetts, 9% for Rhode Island.[42]

These facts begin to suggest the outsized place agriculture still holds in Vermont compared to its role in many other states, but even so they don't capture the full scope of agriculture's contribution to the Vermont economy. Vermont's working farms and forests are largely responsible for the preservation of Vermont's landscape, the scenic beauty of which is a major tourist draw for the state. Thus another leg of the state's economic tripod depends heavily on the ongoing health and success of Vermont's award-winning, world-renowned farms.

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[42] "Agriculture in Vermont: Highlights," published by the Vermont Agency of Agriculture, Food and Markets, 2017, accessed at http://agriculture.vermont.gov/sites/ag/files/pdf/news_media/VT%20Ag%20%26%20Agency%20Overview%20Final%202016.pdf
See also Keough and Deane, "New England Agricultural Statistics 2015," published by the USDA National Agricultural Statistics Service, New England Field Office, Concord, NH, Nov. 2016.

GPI acknowledges the value of farmland by deducting its loss as a cost charge against the economy's bottom line.

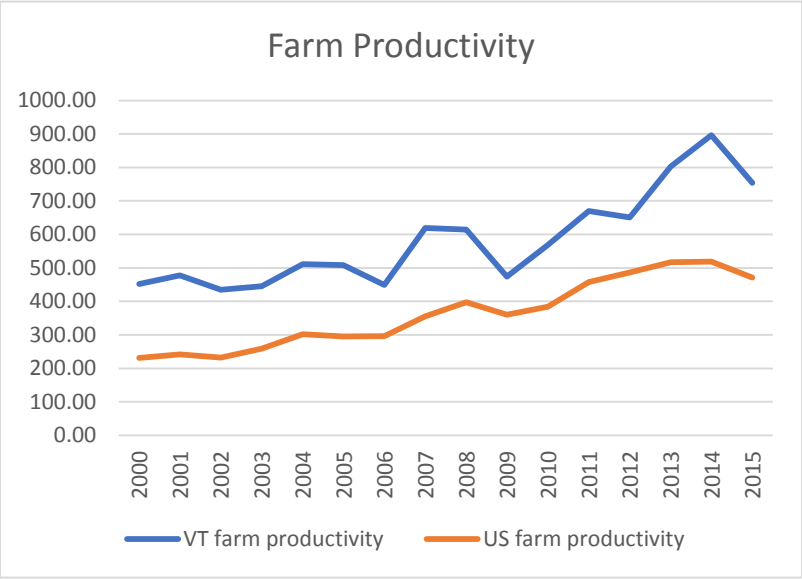

Figure 20: Productivity of farmland, US and VT, by value in current dollars of farm produce sold per acre. USDA data.

In GPI compilations the per-acre valuation of farmland is taken to be the dollar value of production from an average acre of farmland in a given year. As Figure 22 shows, Vermont farmers earn significantly more per acre than the national average.

According to data reported by the USDA, in the fifteen-year period reviewed in this study Vermont lost farmland steadily until 2008, and then saw that trend halted and reversed. By 2012 the state's farmers had added fifty thousand acres to its stock of land under cultivation. The average farm size remained fairly steady—174 acres per farm in 2012 became 171 acres per farm in 2015—while the number of farms grew, from 7000 to 7300. There was no statistically significant loss of farm acreage between 2014 and 2015; the Cost of Net Farmland Change registered here is the cumulative cost accrued before 2015.

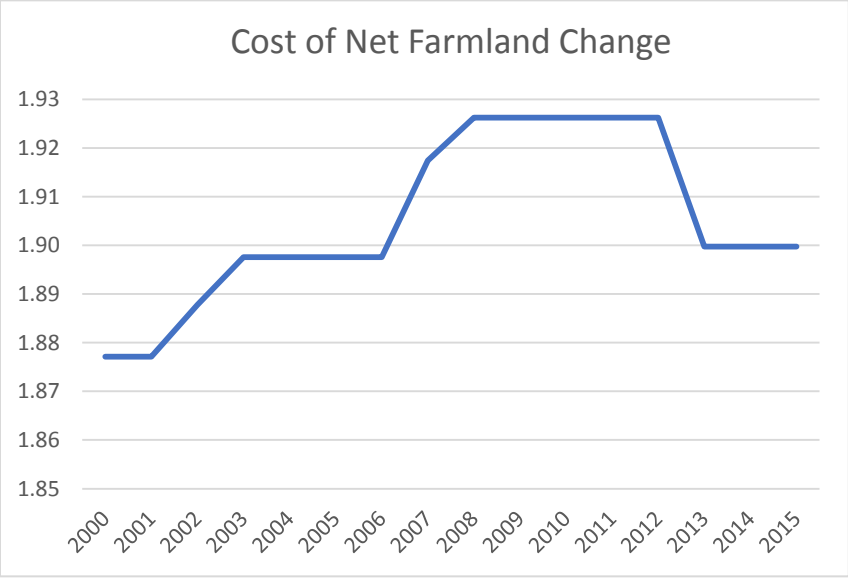

Figure 21: Cost of Net Change in Farmland, in billions of year 2015 dollars

11. Cost of Net Forest Cover Change

Vermont is a deeply forested state, with over 4.5 million acres of forest—approximately 78% of its land area. As most of the state's schoolchildren learn, it wasn't always so. The land's aboriginal forests were first cut by European settlers to make way for agriculture and then were harvested—unsustainably—for a variety of purposes through much of the eighteenth and nineteenth centuries. Vermont forests were cut to feed the voracious appetites of steam-driven trains; for shipment out-of-state as lumber and pulp; to warm houses and run sugaring operations; to make charcoal for smithing and iron refining. In logging's heyday log drives clogged the Connecticut River during the spring snowmelt as saw logs, and later pulp, moved downstream to market. For a time Burlington was the largest lumber port in the country. And in too many towns, local economies experienced the debilitating boom-and-bust cycle that accompanies rapid extraction of resources; when the trees were gone livelihoods and commerce moved on. By 1870, the peak year of deforestation in the state, the land was roughly 70% cleared and only 30% forested.

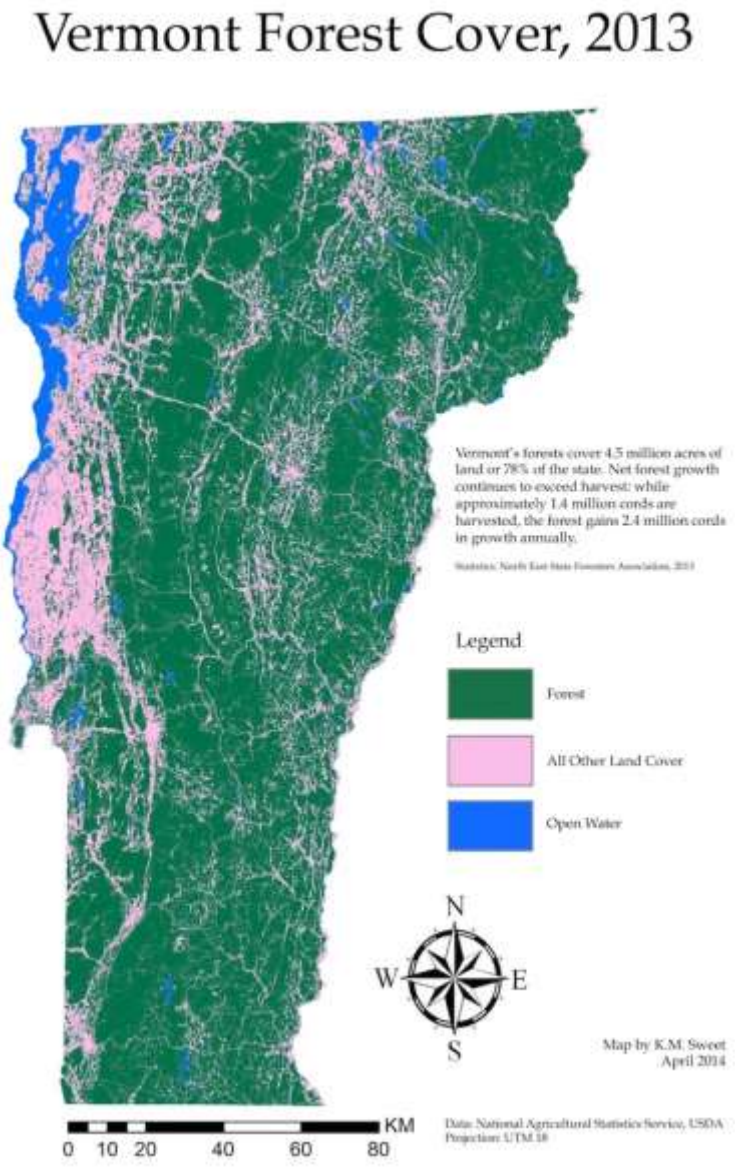

Figure 22: Map of afforested Vermont, 2013

Today, numerous protections have been established to reduce the effects of the dynamics that led to that deforestation. Measures include afforestation programs; preservation of woodland in state and national forests; silviculture and Tree-Farm

programs that endorse sustained-yield forestry; and a use-value appraisal program that reduces tax burdens on land left to "fallow" as forest.[43] Some of these measures reach back to the early 20th century, and find justification today in language that was unavailable to Vermonters then: forests provide valuable ecosystem services to humans, services that do not accrue solely to the land's deed holder. For instance: as Woodstock native George Perkins Marsh was the first to see, by retaining rainwater in spongey soils upland forests provide flood protection to downstream residents.[44] Then too, Insectivorous birds and bats live in forests and reduce pest burdens in nearby areas. Bees and some insect species provide free pollination services; and so on. Because these benefits are not captured by the forest's legal owner, but redound to the benefit of the general public and are part of every Vermonter's birthright, public support for forest maintenance makes economic sense—and it makes sense to count the loss of those ecosystem services as a charge against the economy when the economy converts forestland to other purposes.

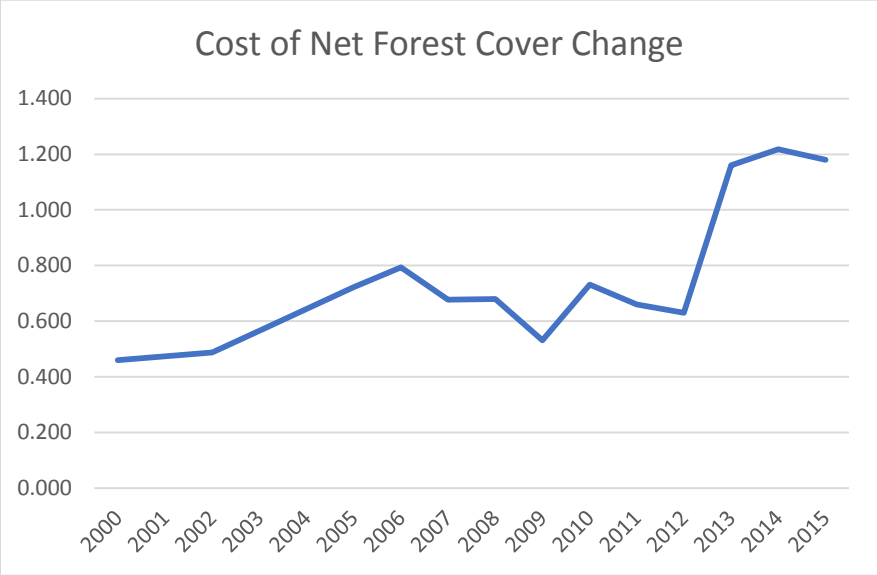

Figure 23: Cost of Net Forest Change, in billions of year 2015 dollars

This year's GPI compilation uses a new, more realistic number for the valuation of ecosystem services from forestland. Previous compilations used the figure of $318 per acre in year 2000 dollars as that valuation. But recent work done for the Georgia Forestry Foundation offers a much more precise—and much higher—estimate of the ecosystem service value of forest. The GFF report disaggregates "typical" forest acreage into a variety of types, depending on species mix, proximity to watercourses and roadways, suitability as habitat for various species, and six other factors, some binary and some multi-variant. The result is a typology of 864 possible forest types, many of which have their own per-acre ecosystem service (ES) valuation.[45] Taking an average of those valuations, this GPI compilation uses the figure of $4553 per acre in year 2015 dollars for its valuation of the ecosystem services provided by an acre of forest.

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[43]Information from "History of Forestry in Vermont," Dept. of Forests, Parks and Recreation, Agency of Natural Resources, at < http://fpr.vermont.gov/forest/vermonts_forests/history>; USDA Resource Update FS-119, "Forests of Vermont, 2016," at < https://www.fs.fed.us/nrs/pubs/ru/ru_fs119.pdf>; and Wharton et al., "The Forests of the Green Mountain State," USDA Forest Service Resource Bulletin NE-158, USDA Northeastern Research Station, Nov. 2003.

[44] George Perkins Marsh, *Man and Nature; or, Physical Geography as Modified by Human Action.* 1864.

[45] Moore et al., "Quantifying the value of non-timber ecosystem services from Georgia's private forests," Final Report to the Georgia Forestry Foundation, January 2011.

Not all forest acreage is the same, as the GFF report documents. A more detailed, labor- and data-intensive methodology here might find the specific valuations for wildlife corridor forest parcels that connect habitats and ranges, improving the survivability of various species of wildlife; or the specific valuations for riparian versus non-riparian forest acreages and the value of the forested acre's flood-mitigation services; or for softwood- versus hardwood-dominant forests, and so on. GPS data would facilitate such categorization, and knowledge of the specific ES value of particular forests would allow policy to be more systematic and rational in its preservation of those values.

Figure 26 shows the 2000-2015 history of the Cost of Net Forest Cover Change in Vermont. Since the per-acre valuation of ecosystem services is constant through these years, the line's movement represents the ups and downs of total forest acreage in the state. Although technical analysis has not been done to demonstrate the point conclusively, the double-dip declines in 2009 and 2012 are suggestive of a correlation with the double-dip GDP recession of those years. The slight decline in Cost of Net Loss (signifying a slight increase in forest acreage) between 2014 and 2015 is unlikely to signal a meaningful trend.

12. Cost of Climate Change

In 2011, Vermont set an ambitious goal to meet the challenge of doing its part to mitigate global climate change: the state would satisfy 90% of its energy needs from carbon-free renewables by 2050. Progress toward this goal can be tracked by reference to this component of the GPI since it tallies the burden of CO2 that the Vermont economy emits. The tonnage of CO2 emissions times a cost-per-ton yields the final figures. As Fig. 26 shows, this cost has trended upward since 2011. It rose $50 million, or 3.0 percent, between 2014 and 2015. By far the largest source of CO2 emissions in the state was the use of petroleum-based fuels (see Fig. 24), which accounted for 5.9 million tons out of a total of 7.8 million tons in 2015.

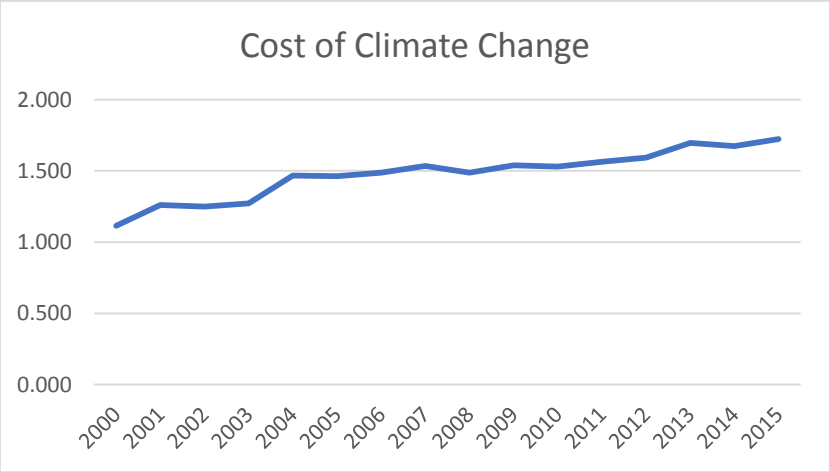

Figure 24: Cost of Climate Change, calculated as total social cost of CO2 emissions, in billions of year 2015 dollars

CO2 emissions are not the only contributor to climate change but other Green House Gases (GHG) are not included in the standard GPI methodology. A

comprehensive profile of GHG emissions in Vermont would include methane, including methane emitted by belching cows, the dairy industry's largest contributor to GHG. (There are more than 134,000 dairy cows in Vermont; there are indications that their emissions can be modified through diet.[46])

While the tonnage of CO2 released is an objective measurement, the dollar valuation of the cost per ton of CO2 emissions—the social cost of CO2-- is controversial. Some of the elements that comprise that cost are unavoidably normative (what is the value of a human life cut short by food shortages wrought by climate change? Does that value vary with nationality or region? Should it vary with prospective life earnings—which means it would vary with nation and region?) and many are simply unknown (how will storm surges from more-powerful hurricanes interact with sea level rise—and will we abandon shoreline communities or defend them?) A burgeoning and technically complex literature attempts to sort through the confusions, using a variety of models and assumptions, and yields no consensus. One study by a commission convened under the UN's Conference of Parties on climate change finds that "past modeling exercises to calculate the global social costs of carbon have produced numbers that *probably underestimate these costs by very large margins"* (emphasis in the original). [47]

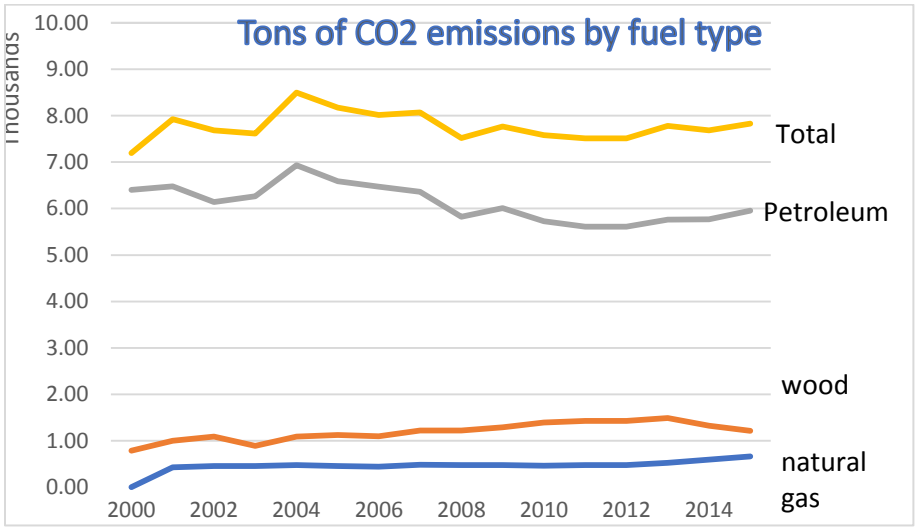

Figure 25: Quantity of CO2 emissions by fuel type, in thousands of tons

[46] Data on the scope of methane emissions from Vermont livestock are referenced in Tim Johnson, "Livestock and methane: What's a consumer to do?", *Burlington Free Press,* June 15, 2014, accessed at https://www.burlingtonfreepress.com/story/news/local/2014/06/15/livestock-methane-consumer/10489267/

[47] Stiglitz and Stern, Commission Chairs, "Report of the High-Level Commission on Carbon Prices," Commission empowered by the Carbon Pricing Leadership Coalition of the Conference of Parties of the United Nations Framework Convention on Climate Change in Marrakech, 2016; report issued May 2017; quotation from p. 52.

This GPI compilation uses the figure of $220 per ton (in year 2015 dollars), well above the official number used by the U.S. of $36 per ton.[48,49] The higher number comes from a study that calculates costs overlooked in the EPA and other studies while accepting the normative framework and discount rates commonly used in carbon pricing studies.[50]

13. Cost of Ozone Depletion

The stratospheric ozone layer functions as sunscreen for life on earth, absorbing significant amounts of ultraviolet light that would otherwise damage organisms. The effects of UV light on humans include instigation of skin cancers and cataracts and suppression of immune systems. It also damages, decays and otherwise prematurely ages a variety of human artifacts and property, including papers, paints, plastics, fabrics, and rubber items that are exposed to it.

In 1973 scientists became aware that chlorofluorocarbons—gases widely used in air conditioning and cooling systems, and also as propellants in spray cans—were capable of destroying ozone in the stratosphere, reducing its protective capacities. Research soon showed that the ozone layer had developed a seasonally fluctuating hole over the South Pole and that the maximum size of the hole was growing from year to year.

In 1985, just twelve years later, the United Nations Environmental Programme facilitated the unanimous adoption by member states of the Vienna Convention for the Protection of the Ozone Layer, which laid out a path for developing a response to the problem; within two years, that process had produced the unanimous adoption of the Montreal Protocol, which banned the production, sale and use of CFCs and other Ozone Destroying Substances. The expeditious movement from diagnosis of a global problem to concerted international agreement on its

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[48] "The Social Cost of Carbon: Estimating the Benefits of Reducing Greenhouse Gas Emissions," Environmental Protection Agency, published on the EPA's historical website reflecting its web presence as of January 19, 2017, accessed Feb. 27, 2018 at < https://19january2017snapshot.epa.gov/climatechange/social-cost-carbon_.html> The dollar figure given above reflects the EPA estimate based on a 3% discount rate, the median estimate offered. The discount rate affects the present-day valuation of expenses likely to be incurred in the future, and so has a large effect on estimates of the social cost of climate change.

[49] See Peter Howard, "Omitted Damages: what's missing from the social cost of carbon," published jointly by the Environmental Defense Fund, the Institute for Policy Integrity, and the Natural Resources Defense Council, March 2014, accessed Feb. 27, 2018 from http://policyintegrity.org/files/publications/Omitted_Damages_Whats_Missing_From_the_Social_Cost_of_Carbon.pdf

[50] Moore and Diaz, "Temperature impacts on economic growth warrant stringent mitigation policy," *Nature Climate Change* 5, 127-131, 2015.

solution gave hope that science-backed policy on other environmental issues, notably climate change, might receive a similar reception.

The ozone layer has begun to recover. Scientists at the National Oceanic and Atmosphere Administration report that the maximum size of the Antarctic ozone hole has been diminishing from year to year.[51] Even so, the consequences of past emissions of CFCs and ODSs are still with us. Thus, this element of the GPI; the ongoing damage traceable to these ozone-depleting chemicals is part of the otherwise uncounted environmental cost that our economy has imposed on us.

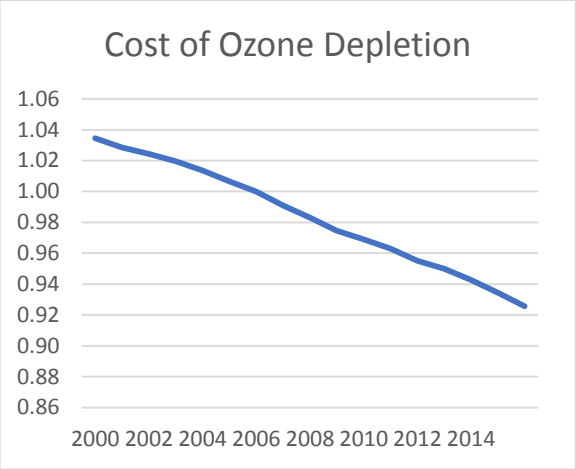

Figure 26: Cost of Ozone Depletion in billions of 2015 dollars

Following other state compilations of GPI, this compilation offers numbers for Vermont that are a step-down from national figures, which are computed as a national cost borne per capita. As Vermont population remains relatively stable while national population grows, under this methodology Vermont's share of the ongoing cost of ozone depletion declines.

[51] NASA/NOAA and Karl Hille, editor, "2016 Antarctic Ozone Hole Attains Moderate Size, Consistent with Scientific Expectations," web posting dated October 25, 2016, accessed Feb. 27, 2018 at https://www.nasa.gov/feature/Goddard/2016/antarctic-ozone-hole-attains-moderate-size

14. Cost of Non-Renewable Energy Resource Depletion

All economic activity involves energy use, and all energy use entails a one-way flow from source to sink, from more useful (like gasoline) to less useful (the waste heat and motion your car produces as it burns fuel). While not all policy makers at the national level would agree, it has become increasingly apparent that our economy needs to be weaned from non-renewable sources of energy. Certainly--by definition--no economy can be sustainable if it relies on non-renewable energy. To the goal of sustainability may be added two other reasons for switching away from non-renewable fuels. Those fuels have source problems: their Energy Return on Energy Invested is falling, making more and more of their stocks less attractive (and sometimes thermodynamically foolish) to mine and pump.[52] And, in complement, they also have sink problems: the planet can no longer absorb the effluents produced by this fuel use without undergoing radical changes in climate.

Figure 27: solar panels in an array in Williston. Photo provided by Green Mountain power.

At $5.20 billion, the Cost of Non-Renewable Energy Resource Depletion is by a large margin the second largest cost deduction in the environmental category, after the adjustment for Income Inequality. This cost is nearly 40% more than the Cost of Water Pollution, the third highest deduction. A charge for the costs we impose on future generations by burning irreplaceable fossil fuels, this indicator's value is pegged to what it would cost us today at market prices to replace those fossil fuels with renewable alternatives. The cost does not reflect what future generations might pay in the market, today (if they could), to wean our present-day economy from fossil fuels. Nor does it reflect the price increases that could be expected by scale-up of renewable liquid fuel production, as biodiesel would compete for increasingly scarce agricultural calories. That price increase would be offset to some degree by economies of scale in the wind and solar photovoltaic industries. All told, though, it seems likely that replacement

[52] Energy Return on Energy Invested (EROI) is an underappreciated concept crucial to the evaluation of energy sources—and to life and civilization. An animal that expends more energy to get food than the food yields has a negative EROI and will soon starve to death; life maintenance requires a positive EROI (and investment in reproduction requires an EROI higher than the level that merely sustains life). Civilizations are built on Net Energy—the energy left after the energy costs of getting that energy have been paid. The more net energy, the more complex—the more developed—the civilization can be. The EROI of fossil fuels is falling, as humans have (very reasonably) exploited high-EROI sources first. The EROI of alternative energy systems is rising, as scale-up and technological efficiencies achieved through additional research reduce the energy investment needed per unit of energy yield.

cost yields a very conservative estimate of the Cost of Non-Renewable Energy Resource Depletion.

While $5.20 billion represents a sizeable portion of the GPI bottom line, the good news is that between 2014 and 2015 the Cost of Non-Renewable Energy Resource Depletion fell by a quarter of a billion dollars, a 4.7% drop. Ongoing implementation of the state's Comprehensive Energy Plan, with its goal of getting 90% of the state's energy from renewables by 2050, certainly played a role in producing this result.

Vermont's commitment to implementation of renewable energy recently earned it high marks from the Union of Concerned Scientists, whose 2017 study "Clean Energy Momentum: Ranking State Progress" put the state second in making progress toward eliminating fossil fuel use. (California was first.)[53] The study used twelve metrics, including percentage of electricity generated renewably; number of clean energy jobs created; electric vehicle use; reduction in CO2 from power plants; and assessments of policies to promote renewable energy, energy efficiency, and carbon reduction. Vermont led the nation in clean energy jobs per capita and in its targeted reduction of carbon emissions, and was in the top five among states in its scores for energy savings, electric vehicle adoption, and energy efficiency policy. Overall Vermont made ten appearances in the top-ten lists for the twelve indicators, the most among all states.

[53] Union of Concerned Scientists, "Clean Energy Momentum: Ranking State Progress," accessed at https://www.ucsusa.org/sites/default/files/attach/2017/04/Clean-Energy-Momentum-report.pdf

Chapter Four

Social Costs and Benefits in Vermont's Genuine Economy

Social Elements of the GPI

The third category of elements that the GPI weighs in coming to its assessment of economic well-being is a mixture of disparate elements. They range from "Personal Costs of Pollution Abatement"—the money we spend on such things as septic systems and catalytic converters, which reduce the environmental impact of our lives—to such economically valuable but unpriced goods and services as those provided by households to themselves (like cooking, cleaning, child- and elder-care) and volunteer work. Unlike the second category of GPI elements dealing with the environment, in which all the indicators are conceptually costs (though some can become negative costs, i.e. they can show improvements that add to the GPI bottom line) here some elements are costs and some are benefits.

The net change in this category for the year was positive: the total contribution it made to GPI's bottom line was $4.97 billion, an increase of 6.89%. Among the largest changes here were the following:

- The Value of Domestic Production rose by 7.9%, as Vermonters reported spending more time in household activities that provide economic value, such as child- and elder-care, routine household maintenance, cooking, cleaning, etc. This indicator, one of the largest contributors to GPI at 22.5% of the total, is responsible for most of the gains in the Social Elements category.
- The Value of Higher Education showed a strong increase, as the number of Vermonters with Bachelor's Degrees rose by 8,900, or two full percentage points, from 152,960 to 161,860. This change increased this indicator from a $2.47 to a $2.59 billion contribution to the GPI's bottom line. Overall, this indicator accounts for nearly 15% of the GPI.

- Other indicators in this section saw undesirable changes. The Cost of Commuting rose by 6.2%, or half a million dollars; the Cost of Motor Vehicle Crashes, down for the decade by an impressive 41.42%, went against trend and rose between 2014 and 2015, deducting a total of $230 million from the GPI. Vermonters worked longer hours in 2015 than 2014, costing an additional $36 million in Lost Leisure Time. While the Cost of Crime rose by 3.1%, this did not have a large impact on GPI, since this indicator accounts for less than a quarter of a percentage point toward the final tally.

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15. Market Value of Domestic Production

GDP measures goods and services that move through markets. Households provide a vast array of goods and services to themselves that don't move through markets—no money changes hands. This domestic production nevertheless contributes greatly to our economic well-being. GPI counts these goods and services, assigning a dollar valuation to the amount of time that we spend doing various domestic chores that have ready market replacements: cooking, cleaning, sewing, washing, ironing, child- and elder-care, do-it-yourself home projects, and so on.

GPI uses estimates of how much time we spend in these activities that are published by the Bureau of Labor Statistics, which has administered the American Time Use Survey since 2003. In 2016 the ATUS found that 85 percent of women and 69 percent of men spent some time engaged in domestic production during the week; on the days that they engaged in these activities, women spent an average of 2.6 hours while men spent 2.0 hours. (The ATUS also found that among full time workers men worked an average of .6 hours longer than women.)

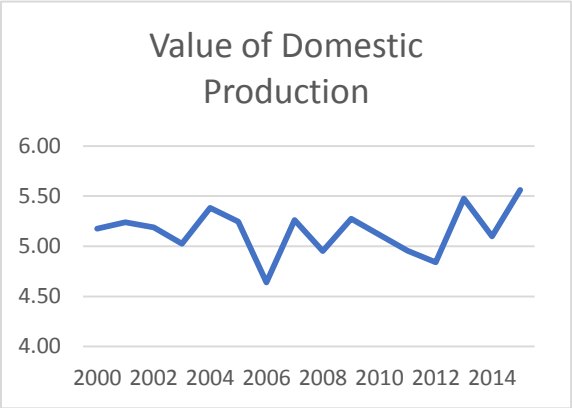

Figure 28: the Value of unpaid domestic production in Vermont, in billions of 2015 dollars

Unfortunately, the ATUS does not provide good state-level data for small states; the sample size is too small to offer sturdy generalizations. GPI calculations for Vermont continue be forced to assume that Vermonters spend their time the way most Americans do. The Value of Domestic Production figure used in this compilation comes from multiplying the number of Vermonters by the average number of hours the typical American spends in domestic production and then multiplying that result by a Vermont-specific average wage for domestic work.

At $5.56 billion, this category is a large contributor to the GPI's bottom line, accounting for fully 30% of the $18.299 GPI total. As Fig. 30 shows, the Value of Domestic Production is volatile within a range of $0.5 billion, or 10% of the indicator's value.

Data specific to Vermont would of course yield greater accuracy in this indicator. Given that compared to the country as a whole a higher percentage of Vermont residents live in rural areas, and given Vermont's rural tradition of self-reliance, it seems possible that state-specific data on time use would show that Vermonters spend more time in domestic production than the average American.

16. Cost of Family Changes

As Anielski and Rowe put it in one of the first national-scale GPI compilations in 1999, arguably the most important economic asset that most Americans have is their family. Whatever their shape, size, or composition, strong families ground us—and also contribute very concrete, economically valuable but unpriced benefits to our wellbeing. These benefits go beyond provision of the goods and services tallied under "Value of Domestic Production." GPI doesn't count these other benefits directly, but does register their loss as a cost in this indicator, "Cost of Family Changes."

When families deteriorate or dissolve, their members lose the benefits of companionship, simple human engagement, positive other-regard, the security of an economic, social and psychic "safety net," practical support in meeting life challenges, and other amorphous but nonetheless real satisfactions and benefits. The nature of those benefits becomes more obvious in their absence: the lone, family-less individual will often turn to generally less satisfactory commercial replacements for the psychic and social benefits that family provides, and even so he or she will, on average, endure more illness and enjoy a shorter life. Children not reared in a strong family support system experience poorer health outcomes and have trouble in school, both of which can lead to diminished life expectations and achievements.

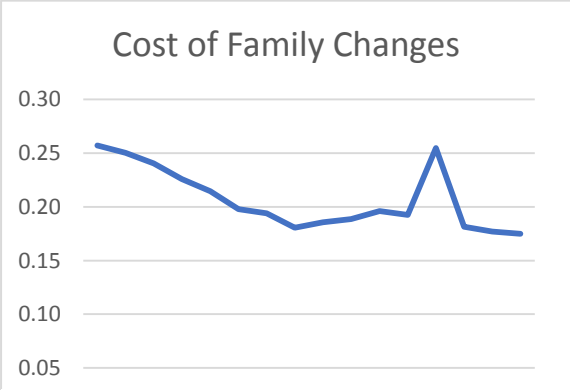

Figure 29: Cost of Family Changes in year 2015 dollars The spike in 2012 is due to an anomalous reported increase in average television viewing hours per Vermont household, which investigation has not been able to confirm or disconfirm.

The sturdiness of families is hard to calibrate, but standard GPI methodology uses two objectively determined variables to estimate it. One is the sheer number of divorces, a clear marker of family breakdown; the other is the average number of hours that a household watches television, which is a proxy for less obvious forms of family breakdown.

As to the first: when couples divorce, GDP records the dissolution as a happy time: lawyers are engaged and paid, and, when one household splits into two, duplicates of all sorts of consumer products (from the housing itself to various appliances to spare clothing for the children) are suddenly required. But these consumer-products expenditures don't raise anyone's standard of living; they aim to re-establish the pre-divorce material standard that each of the divorced partners had. It's likely that at least half the people who go through divorce would see the legal and other expenses as making a solidly positive contribution to their overall happiness and standard of living, but GPI treats that expense the way it would treat other remedial expenses: what is gained isn't new wellbeing but the restoration of a standard of wellbeing that existed previously. Divorce, in effect, fixes a broken window (see note 9). On average divorcing couples spend $9363 on fees and legal and other expenses.

There are also costs borne by and on behalf of children affected by the family breakup: an increased need for transport between households, increased childcare, sometimes the expense of counseling, and long-lasting consequences of difficulties at school, at work and in personal relationships. Studies have pegged these costs at $14,000 per child.

Researchers have found that as television viewing time in a household increases, the ability of familial relations to satisfy human needs decreases. So too do adult-child interactions. Childhood obesity increases with hours of viewing, as does any viewer's risk of developing type 2 diabetes and depression.[54] In the GPI accounting system, average hours of viewing time come from the Nielsen organization, while estimates of the cost per hour of viewing time come from scholarly literature in public health and psychology. The per-hour cost of television viewing is estimated at $0.56, a small number that grows into significance when multiplied by hours per day spent watching television, times 365 days a year, times the number of households with children times the average number of children per household. In 2015 this computed cost of television watching in Vermont was $105.66 million.

While the hours Vermont households spent watching television per day did not change significantly after 2010, clocking in at 5.78 hours per day, on average, according to Nielsen Media Research[55], from 2010 through 2015 the number of divorces per year declined, accounting for the overall decline in this indicator in those years. As compared to 2000, both hours of viewing and the number of divorces are down considerably: hours of viewing fell from 7.58 hours per household per day to 5.78, while the number of divorces in a year fell from 2526 to 2179.

The drop in television viewing time may be a spurious result, for it may simply represent a trade-off for engagement with other kinds of screens (computer, smartphone, TV-connected devices such as games) whose viewing has the same effects on individual health and family

[54] Teychenne et al., "Sedentary behavior and depression among adults: A review," *International Journal of Behavioral Medicine* 17, 4: 246-54, December 2010.

[55] The value for 2012 is 8.74, an anomalous result that may not be accurate. Investigation has been unable to confirm or disconfirm the figure.

cohesion that television viewing does. Again according to the Nielsen company, in 2016 Americans over the age of 18 spent almost as much time on other screens as they did watching television—40% of all media engagement time for those screens as opposed to 44% of media engagement time for television.[56] (The remainder was for radio.) This suggests that the actual cost of screen-based media engagement is nearly double that for television viewing alone. Future iterations of the GPI could be improved by taking this cultural shift into account and adjusting this indicator accordingly.

17. Cost of Crime

Crime costs us. Some of the costs are obvious: theft costs us money or property, aggravated assault imposes medical costs on us, murder costs us lives. But some of the costs not so easily counted. Victims experience pain and a variety of kinds of suffering, including anxiety, fear, depression, insecurity, anger. Along with physical pain, these emotional responses can affect the victim's health and earnings and quality of life, and therefore have concrete economic costs that can, in principle, be denominated in dollars. (Jury awards in civil suits do just that.)

There are other tangible costs to society as a whole. In the largest view of the economy all the money that we as a society spend preventing and dealing with crime is not an economic benefit but a cost that we bear. Police, courts, corrections, all the machinery for the administration of justice: none of it improves our economic wellbeing as such. Our expenditures on them are defensive and remedial; they are an opportunity cost imposed on us. For that reason these costs are deducted from GPI's bottom line.

Type of Offense	tangible cost	intangible cost	total cost
Murder	1,414,817	8,474,465	9,889,282
Rape/Sexual Assault	45,414	219,786	265,070
Aggravated Assault	21,437	104,611	117,818
Robbery	23,530	24,853	46,579
Arson	18,087	5,651	23,232
Motor vehicle theft	11,597	288	11,859
Burglary	6,791	353	7,114
Embezzlement	6,033	n.a.	6,033
Vandalism	5,350	n.a.	5,350
Larceny/Theft	3,878	11	3,888

Table 4: Cost estimates of various types of crime. From McCollister et al., 2010

[56] AC Nielsen Co., "The Nielsen comparable metrics report: Q4 2016," May 2017, accessed at http://www.nielsen.com/us/en/insights/reports/2017/the-comparable-metrics-report-q4-201

Exactly how much does crime cost us? One recent, widely-cited review of the "crime-cost" literature (McCollister et al., 2010)[57] surveyed scholarship, reports on jury awards and various government estimates and came to the valuations given in Table 4. These values, when multiplied by the incidence of each crime in Vermont, give us the Cost of Crime for the state. These are new valuations for this year's compilation of the GPI, and they've been back-cast to earlier years to retain comparability. Previous iterations of the GPI used Department of Justice figures on cost of various crimes though those valuations were limited to tangible costs experienced by victims (the medical expenses, cash losses, property theft or damage and lost earnings); they excluded all intangible costs and the significant opportunity cost of maintaining a criminal justice system.

The cost-of-crime figures in Table 4 are national figures, not specific to Vermont. It is possible that efficiencies in the administration of criminal justice and other factors specific to Vermont could make these figures inaccurate for the state.

All told, in 2015 crime cost the citizens of Vermont $231.5 million, up slightly from 2014's total of $223.7 million. The 2015 figure represents a $35.8 million decrease (in constant year 2015 dollars) from the value of $267.3 million in year 2000.

Even though homicides are relatively rare in Vermont, as Fig. 32 illustrates they are the major driver of the state's Cost of Crime. In 2015 Vermont had 10 murders, or 1.6 murders per 100,000 residents, placing it second among states (only New Hampshire had a lower rate that year) and far from the bottom (Louisiana had the most murders per capita, with 10.5 per 100,000). The national average for homicides that year was 5.3 per 100,000. The volatility in Vermont's Cost of Crime is a product of the relative rarity of the crime of murder in Vermont and its high imputed cost; a few additional murders in a year show as a dramatic increase, as when 2016 saw 14 murders in the state.

Figure 33 offers charts showing the incidence of major crime types in Vermont from 2000 to 2016. Several show an encouraging decline in those years. The number of robberies per year does not show a decreasing trend, but seems especially volatile, bouncing between an upper bound of 130 and lower limit half that. This puzzling result merits further investigation.

[57] Kathryn E. McCollister, Michael T. French, and Hai Fang, "The cost of crime to society: New crime-specific estimates for policy and program evaluation," *Drug and Alcohol Dependence* 108 (2010) 98-109, April 2010.

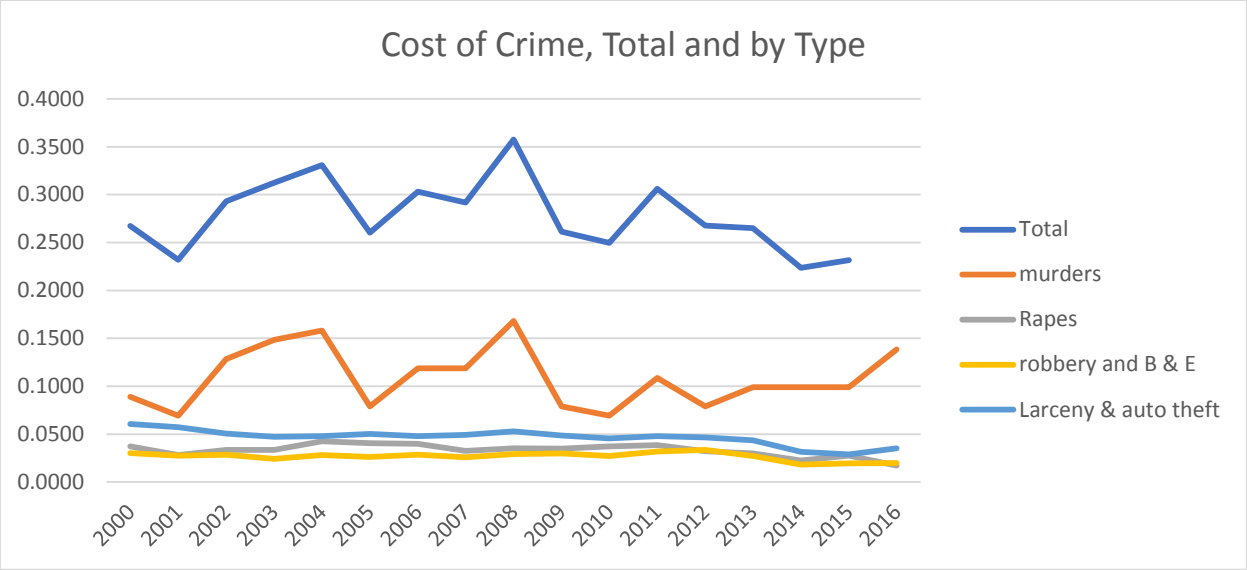

Figure 30: Cost of Crime in Vermont, by type of Crime and total cost, in year 2015 dollars

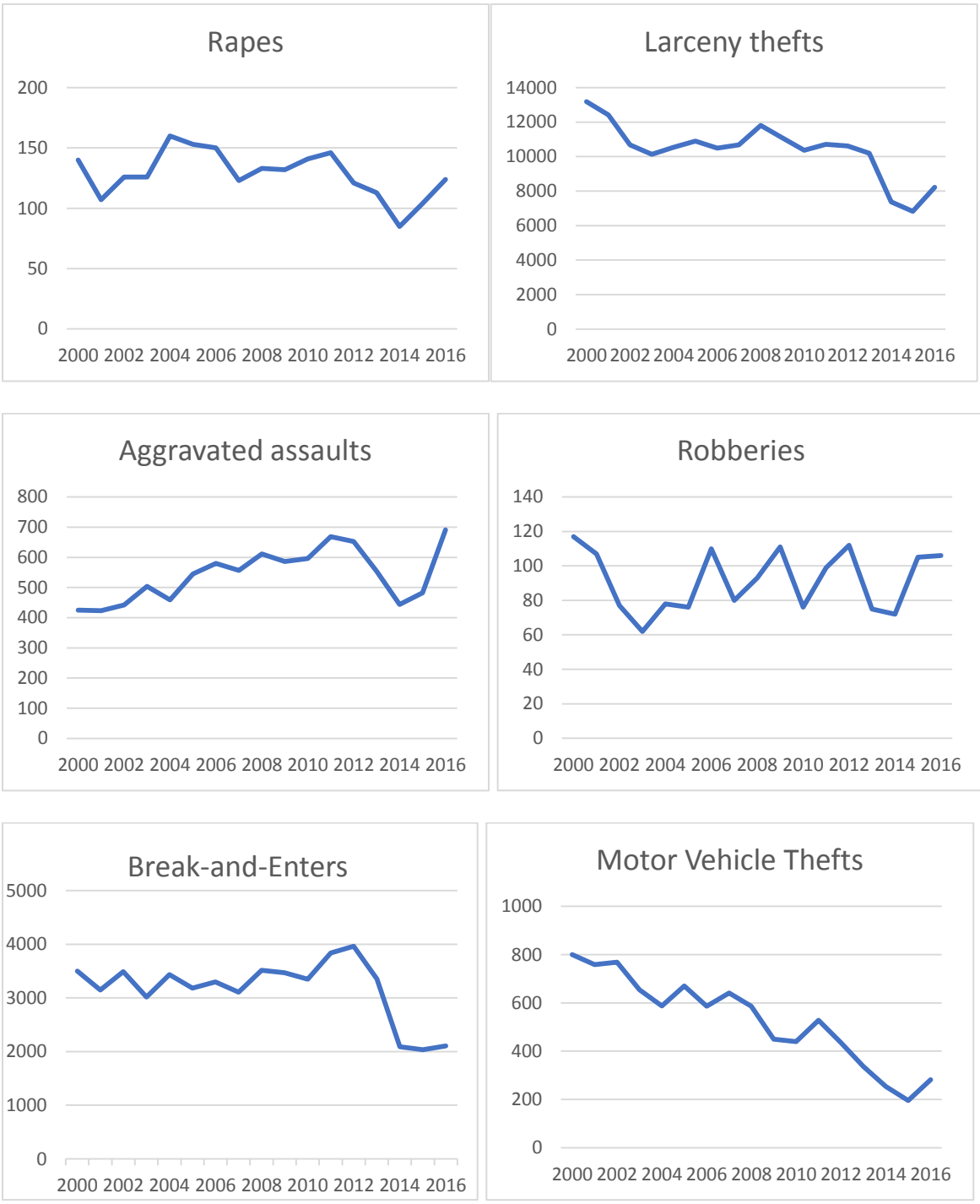

Figure 31: Incidence of various crimes in Vermont
Data from FBI Uniform Crime Statistics Annual Crime Reports

18. Cost of Personal Pollution Abatement

Since GDP measures nothing more complicated than the churn of money in the economy—the amount that gets spent in a given year on all final goods and services--it counts the money we spend dealing with pollution as a positive contribution to our wellbeing. This is another instance of the Broken Window Fallacy mentioned in Chapter One: it tells us that as long as we spend money to clean up after ourselves, the more we pollute, the more progress the economy makes.

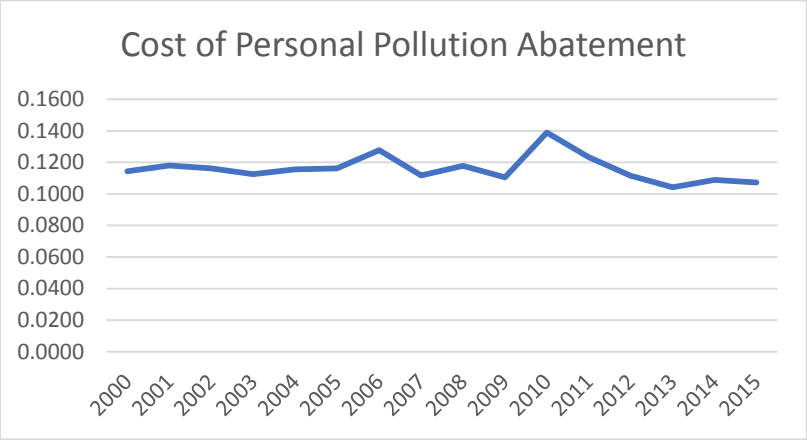

Figure 32: Cost of Personal Pollution Abatement in billions of 2015 dollars

GPI rejects this fallacious thinking by counting pollution abatement as a debit item. Here GPI counts just *personal* pollution abatement expenses because the other categories of pollution abatement expenses are already taken into account. The money that firms spend to reduce their impacts on the environment is presumably included in the purchase price of the goods and services they produce. Money spent by governments to prevent or remediate pollution is paid for through taxes or government bonds, the financing and payment of which reduce the money we have for Personal Consumption Expenditures, the starting point of GPI. But we as individuals also spend money specifically to reduce our impacts on the environment—money that doesn't go toward consumption but to prevent and remediate an environmental harm-- and the national income account needs to be adjusted to reflect that fact.

These personal abatement costs fall into three broad categories: money spent to limit impacts on water, money spent to limit impacts on air quality, and money spent to handle solid waste.[58] In the first category GPI counts the money spent on sewer and septic systems; in the second it counts the paid value of automotive catalytic converters and air filters; and in the third it tallies tipping fees and landfill tonnages.

[58] Ecologists point out that most solid waste is never "disposed" of; it is rather inventoried in what humans hope will be long-term storage, quarantined for the time being from groundwater and other contact with the larger environment.

In 2015, Vermonters spent $107 million in out-of-pocket expenses reducing the impact of their lives on the environment through catalytic converters, sewer and septic systems, and landfill tipping fees. This represents a slight decline over 2014's $109 million expense. Overall the data here exhibit a slight downward trend, with the notable exception of 2010, which may be an artifact of a problematic data point. (The number of new septic systems for 2010 is given as 4640, which is nearly five times the number for the preceding and succeeding year. Additional staff work might clarify this anomalous value.)

Another problem with the methodology for this indicator is that raw data on new motor vehicle registrations in Vermont (information that is needed to price our out-of-pocket expenditures to maintain air quality) are not readily available from public sources.[59] Absent such data, GPI compilations have inferred the number of new registrations from total vehicle registrations minus a figure for average annual losses to age-out of the rolling stock. But in a recession year, consumers make do with what they have, postponing or foregoing purchase of a new vehicle. Figure 35 shows that Vermonters reduced their purchases of new vehicles by 4,481 units in 2008, a decline not captured in the GPI methodology. (Unfortunately, data from this source doesn't extend beyond 2008.) The reliance on inference rather than data leads the GPI calculation to overstate new vehicle purchases, hence Cost of Personal Pollution Abatement, in recession years. The overall effect is to add about 4% to this indicator, or two-hundredths of one percent of the 2008 GPI bottom line of $17.17 billion (in constant year 2015 dollars). In terms of the total GPI the margin of error is minor, but any error here diminishes the potential effectiveness of this part of the indicator as a policy tool. Good, real-time data from the Department of Motor Vehicles would sharpen this part of the indicator.

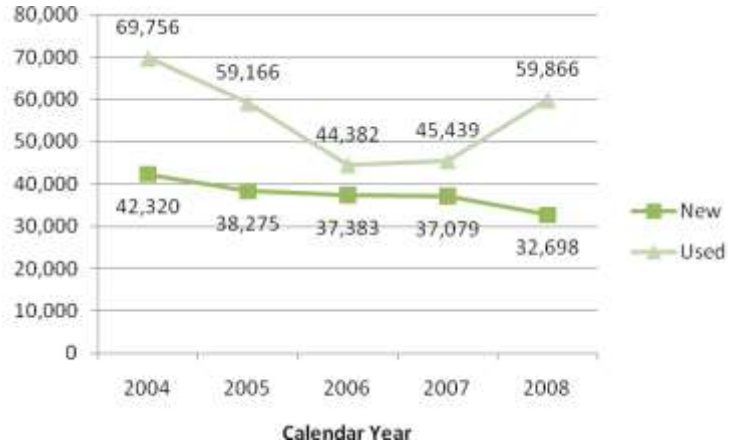

Figure 33: Sales of new automobiles in VT, 2004-2008

Vermonters rank among the most vehicularly minded people in the United States, with 1047 vehicles per 1000 residents. In general, rural distances and the exigencies of non-urban life encourage vehicle ownership and increased vehicle use by drivers of all ages, while urban agglomeration brings population density sufficient to make mass transit a more practical option. New York City residents own so few cars that the entire state has just 539 registered light vehicles per 1000 residents, while Montana tops the list at 1594 vehicles per thousand residents. Vermont's neighbors New Hampshire, Maine and Massachusetts rank 40th, 20th, and 6th, respectively, with 974, 830 and 747 light vehicles per thousand residents.

[59] Jennifer Kenyan, Karen Glitman and Richard Watts, "The Vermont Transportation Energy Report," UVM Transportation Research Center report #09-004, August 2009, p. 7. The authors contracted for proprietary data with R.L. Polk & Co., an international firm, to provide Vermont-specific data on automobile purchases.

19. Value of Volunteer Work

Like Domestic Production (indicator # 17), volunteer work is unremunerated work that is identical to work done for pay. It is part of the value-production of the economy; the services provided by volunteers contribute to our economic well-being. GPI estimates their value and adds that value to the bottom line.

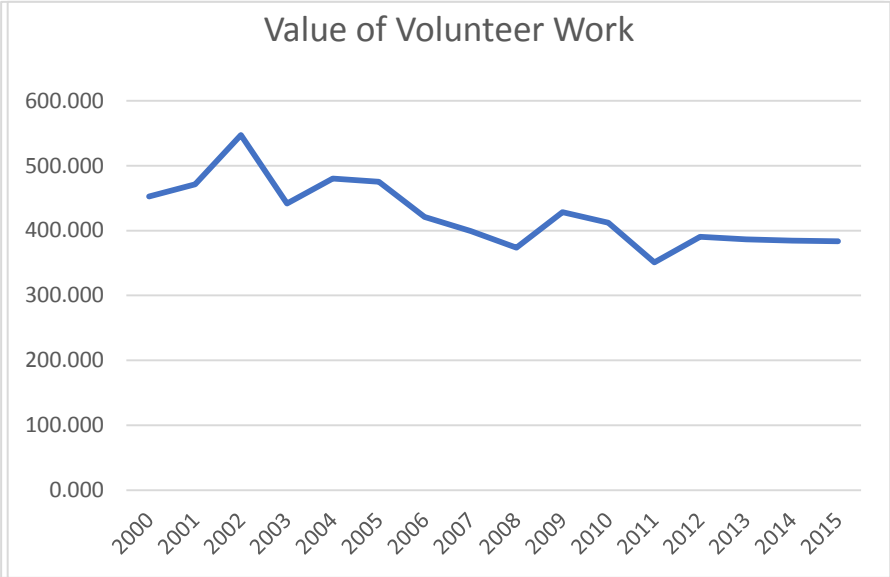

Figure 34: Value of Volunteer work in Vermont in millions of year 2015 dollars

In 2015, volunteer workers added $383 million in value to the Vermont economy, down slightly from 2014's value of $384 million and well off the highest value for the fifteen years under review, 2002's mark of $547 million.

Current GPI methodology systematically undercounts Vermont volunteerism. The definition of volunteer work used in the data base from which the GPI figures are drawn is "work done without any payment." That seems reasonable enough; but every town in Vermont has numerous town officials who receive small annual stipends for what they do—honoraria on the order of $100—that are by no means full remuneration for the hours worked or the responsibilities exercised. These officials are excluded from the official definition of volunteers because of those stipends. Similarly, many school districts employ volunteer coaches for a symbolic sum in order to ensure that the volunteer is covered under liability insurance. If all of those acts of volunteerism were included in the figures presented here, the figures would be significantly larger.

20. Cost of Lost Leisure Time

As noted in Chapter One, Nobel Laureate economist Simon Kuznets, the inventor of national income accounting, warned that GDP was no measure of economic wellbeing. "Distinctions must be kept in mind," he said, "between costs and returns," for GDP doesn't distinguish between the two. One cost that GDP doesn't count at all is the lost leisure time of workers who raise their incomes (and GDP) by working longer hours. And yet clearly there is a difference in economic wellbeing between two workers earning the same income, one of whom works 37 hours a week and one who works 50 hours a week. Though Bureau of Economic Analysis data count both workers as full-time employed, the latter worker has sacrificed leisure time for income and the sacrifice ought to be tallied. It deprives the worker of time that could be spent in a variety of life satisfactions (parenting, social engagement, recreation, relaxing, or whatever a person's taste suggests). Opportunity costs are real costs and they need to be subtracted from the benefits that are otherwise produced.

Figure 35: Cost of Lost Leisure Time in billions of year 20215 dollars

The calculation of lost leisure time is straightforward: the GPI compilation takes the average number of hours worked per "unconstrained" worker (one who is full-time employed or voluntarily part-time),[60] subtracts the number of hours that represent the usual full-time workload of 40 hours per week, and treats the rest of the hours worked as lost leisure time. The dollar valuation of those hours is the average hourly income of workers in Vermont.

[60] Longer work weeks require sacrifice of leisure only for unconstrained workers, those who do not have "unprovided hours," i.e. those who work full-time or, if working part time, do so through their own choice, not employer imperative. This figure is calculated for Vermont's unconstrained labor force. See the first paragraph of the treatment of indicator 4, Cost of Unemployment, for more on these definitions.

As Figure 37 shows, Vermonters have been paying significant amounts of lost leisure time over the past ten years, although the burden varies and has recently declined. In 2015, GPI methodology calculates that Vermont workers gave up a total of 87.6 million hours of leisure in order to work longer hours, down considerably from the previous year's value of 98.3 million hours.[61] In 2015 this unheralded cost borne by Vermonters amounted on average to $6,236 per unconstrained worker, as shown in Table 5.

Factor	2000	2006	2015	Fifteen-year Change	As a % change
Lost leisure hours per year per unconstrained worker	206.2	275.3	276.1	69.9 hours/year	+ 33.8 %
Value of lost leisure hour (average hourly wage)	$19.75	$20.28	$22.10	$2.35	+ 11.9 %
# of Vermont unconstrained workers	313,776	333,615	320,412	6,636	+ 2.11 %
Total Cost of Lost Leisure Time	$1.28 billion	$1.86 billion	$1.98 billion	$700 million	+ 54.7 %
Cost per unconstrained worker	$4080	$5583	$6236	$2156	+52.8%

Table 5: Elements of Cost of Lost Leisure Time. An "unconstrained" worker is a worker who is either full-time or part-time by choice. Dollar valuations in year 2015 dollars. Hours from the American Time Use Survey, Bureau of Labor Statistics, except figure from 2000 is interpolated.

It is instructive to compare this development with the increasing income concentration documented in indicator 2, where the Index of Income Inequality is calculated. The real average hourly wage rose between 2000 and 2015, and average lost leisure hours per worker per year rose slightly as well, which together suggest that average incomes should have risen; and indeed they did, a little. From 2000 to 2015 the Vermont median real income rose from $55,203 to $60,246, an inflation corrected gain of 9.1% over 15 years, or 0.584% per year. But averages and median figures don't tell the whole story. The number of Vermonters living at or below the poverty level increased in 2016; the number of Vermonters reporting food insecurity and seeking food assistance has yet to decline to its pre-recession level; and since 2000 the wages of income earners in the lowest 10th percentile scarcely improved at all.[62] As the Index of

[61] Data on length of work week comes from the American Time Use Survey, which reports on the country as a whole, not by state. The data given here are thus in part a "step down" from national data, on the assumption that the closest estimate of Vermont laborforce characteristics can be gotten from US laborforce characteristics. This may or may not be a valid assumption.

[62] Public Assets Institute, "The State of Working Vermont 2017," published by Public Assets Institute, Montpelier, VT, accessed at <http://publicassets.org/library/publications/reports/state-of-working-vermont-2017/>, data from pp. 11, 17, and 9.

Income Inequality shows, the increase in economic benefits as measured by income growth over the past decade and a half have disproportionately accrued to those in upper income brackets. This has left many Vermont families about the same or worse off economically, even though on average Vermonters work slightly longer hours for slightly larger pay. Bottom line: Over the past fifteen years many Vermonters gained little financially but worked longer hours, leaving them less leisure time to enjoy the fruits of their work.

21. Value of Education

The value of a college education is not captured solely by the person who obtains it. Education at every level has significant externalized economic benefits, i.e. benefits that accrue to the community at large. For instance, an educated workforce attracts investment dollars to an area, improving economic conditions for all. The higher incomes associated with an educated workforce can either ease tax rates on the population as a whole or allow the population to invest more readily in public goods (goods that can be provided efficiently only through public expenditure, since markets fail to assign resources to them at the appropriate level). Educational attainment among workers has "spillover" effects, raising the productivity and earnings of peers and fellow workers. And an educated populace has higher rates of civic engagement and lower demand for social services, among other societal benefits.

Hill, Hoffman and Rex (2005) found that this externalized value of a Bachelor's degree amounted to $16,000 per degree, a figure that becomes $22,091 when inflated to 2015 dollars.[63] Following other GPI studies, that number is used here.

In 2015, the Value of Higher Education rose from $4.8 billion to $5.08 billion, an increase of 5.8% over the 2014 amount. According to U.S. Census Bureau data, the proportion of the Vermont population twenty-five years old or older holding a Bachelor's or higher degree went from 37.7% to 38.7%, as the absolute number in that category increased by 3900 (from 153,118 to 157,018). [64]

[63] Kent Hill, Dennis Hoffman, and Tom Rex, "The Value of Higher Education: Individual and Societal Benefits," report issued by Arizona State University's Productivity and Prosperity Project, Oct. 2005, accessed at https://www.asu.edu/president/p3/Reports/EdValue.pdf

[64] U.S. Census Bureau American Fact Finder, American Community Survey, Vermont, 2014 and 2015, accessed at <https://factfinder.census.gov/bkmk/table/1.0/en/ACS/14_5YR/S1>

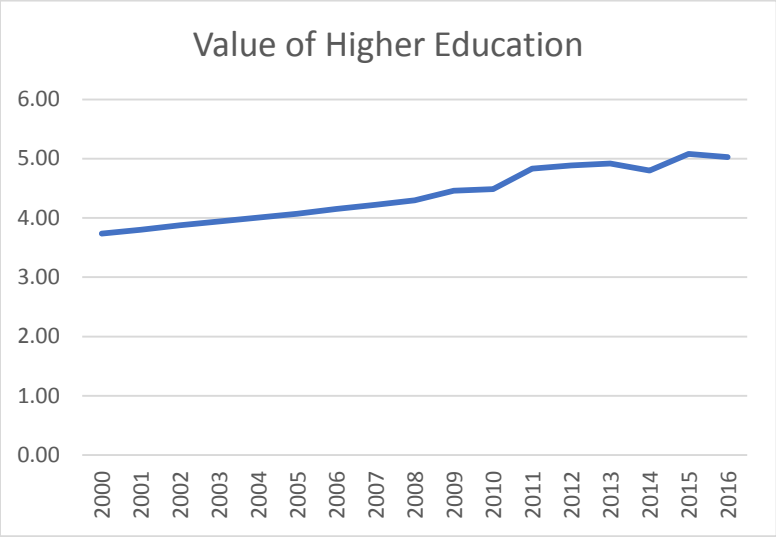

Figure 36: Value of the externalized benefits of higher education in Vermont, in billions of year 2015 dollars.

Looking ahead to 2016, the total societal value of Vermonter's higher education is calculated to be $5.02 billion, a slight drop from the previous year's value of $5.08 billion. The number of Vermonters with Bachelor's degrees fell slightly, by 1,830, accounting for the decline. As Figure 38 shows, this value has steadily increased over the years of the study with some minor declines in just three of the years, 2016 included.

According to data published in the 50-state model of GPI done in 2015, Vermont ranked fifth among states for percentage of the population with Bachelor's or higher degrees. Setting aside the District of Columbia (a special case, with a Bachelor's-or-higher degree rate of 52.5%), Massachusetts has the highest rate of higher education completion in the country, with 39.1% of its citizens twenty-five years old or older holding a Bachelor's or higher degree. That figure yielded a Value of Higher Education of $38.89 billion for Massachusetts in 2015 dollars. Since the valuation for the degree is presumed to be the same in all states, and since the Bachelor's degree is a pre-requisite for graduate or professional degrees, the gross Value of Higher Education in a state reflects Bachelor's completion rates times the number of inhabitants twenty-five years old or older.

There are other ways to evaluate the state's relative standing in educational attainment. According to a recent analysis done by Wallet Hub, Vermont ranks fourth among "Most Educated States."[65] Their ranking reflects two variables--Educational Attainment (number of years of successful schooling) and Quality of Education. Each variable has several sub-indicators.

Educational Attainment totes up the share of adults 25 and older with:

- at least a high school diploma;
- at least some college or an AA degree;
- at least a Bachelor's degree;
- a graduate or professional degree.

Quality of Education looks at more variables, including

- U.S. News and World Report's ranking of state school systems;
- number of enrolled students in top universities;

[65] https://wallethub.com/edu/most-educated-states/31075/

- public high school graduation rate;
- public college graduation rate;
- NAEP Math and Reading Test Scores;
- Share of high school students getting credit through Advanced Placement exams; and
- racial and gender gaps in educational attainment.

Vermont's score was 71.14 out of a theoretical maximum of 100. Massachusetts was ranked number one, with a score of 81.92. Other New England states scoring well were Connecticut, third, with a score of 71.90, and New Hampshire, seventh, with a score of 68.28. Maine and Rhode Island ranked 22nd and 23rd with scores of 52.45 and 52.16 respectively.

One methodological improvement that could be made to the GPI measurement here would begin with acknowledging that education not only has social benefits but that failure to educate has social costs. Some part of those costs are already captured in the GPI metrics: lower degrees of educational attainment correlate with lower earnings, so one effect of low educational attainment is captured in the figures for Personal Consumption Expenditures. The earnings gap between high school dropouts and high school finishers is about $25,000 a year, on average.[66] But low educational attainment has other economic effects not captured in the figures for reduced income. The U.S. Department of Education calculates that the average dropout costs society about $250,000 over their lifetime in terms of lower tax contributions and higher reliance on social services including Medicaid, Medicare and various forms of social assistance.[67] Given an average life expectancy of 70 years for high school dropouts, that works out to $5555 per year per dropout. That number times the number of adults twenty-five years old or older who have not completed high school would yield a figure for the cost of under-education that could then be deducted from this indicator's bottom line. Clear and simple though that change might be, this report uses the older methodology in order to retain comparability with other state-level GPI compilations.

[66] U.S. Department of Education, "Trends in High School Dropout and Completion Rates in the United States: 1972-2012. Compendium Report." National Center for Education Statistics document NCES 2015-015, June 2015, p. 1. Accessed Jan. 25, 2018 at https://nces.ed.gov/pubs2015/2015015.pdf

[67] Ibid., p. 1

22. Services of Highways and Streets

As is shown by any toll road, highways and streets provide a valuable service whose worth can in principle be denominated monetarily. Most roads and streets are laid and maintained at public expense. GPI counts their service value, making them the only category of public expense to have its own indicator. Some other types of governmental expenditures show up in existing GPI categories: transfer payments boost the Personal Consumption Expenditures of those who receive them; the costs of the administration of justice are tallied in the Cost of Crime; and public investment in schools shows up, if slightly obliquely, in Value of Education. Most other government expenditures are excluded from GPI because they fall into the category of defensive or remedial expenditures that aim to secure or restore a quality of wellbeing that has already been attained. These include all the money spent on such things as national defense, disaster relief, regulatory regimes, and air traffic control, among others. Such defensive and remedial expenditures are exactly the expenses that GPI was designed to deduct from the GDP to arrive at a net, rather than gross, estimate of material wellbeing. But highways and streets provide an economically valuable service that isn't caught by any other category of public spending; thus its presence here.

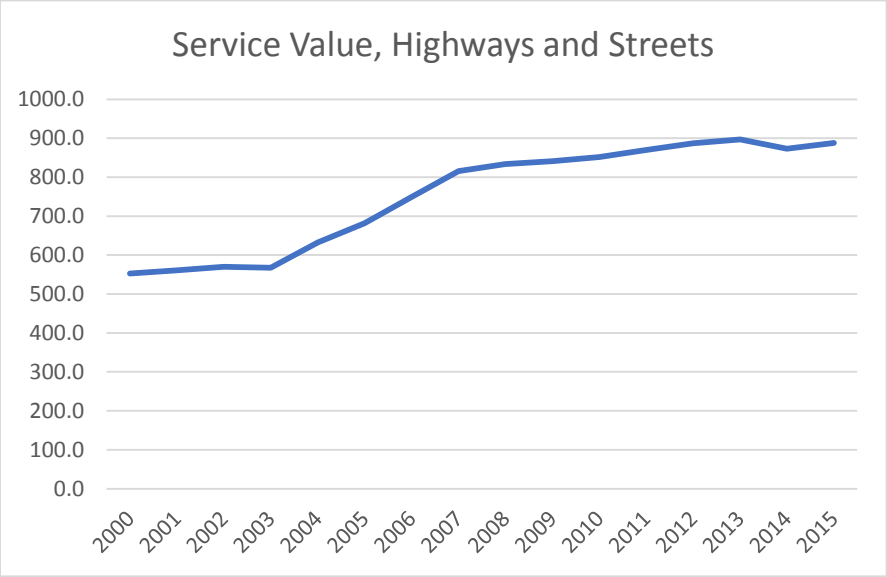

Figure 37: Service value of Vermont Highways and Streets, in millions of 2015 dollars

The service value of a mile of highway or street is taken from the Bureau of Economic Analysis' National Income and Product Accounts tables and applied to Vermont's percentage of the US stock of highways and streets. This method showed that in 2015, the service value of this transportation infrastructure was $887.8 million in 2015 dollars.

As Figure 39 shows, the service value of Vermont's highways and streets rose steadily since 2000, though the rate of increase varied slightly and saw one slight downturn. This result comes from the fact that the sheer mileage of the US stock of highways and streets has steadily risen at a varying rate while the proportion of that stock found in Vermont has declined slightly

over these years. Vermont's miles of maintained highways remained fairly constant from 2000 to 2015, falling by 21 miles in that time period, while the US as a whole added 235,000 miles to its stock of highways and streets, an increase of 5.9%.

23. Cost of Commuting

One of the uses to which the streets and highways of Vermont are put is to allow Vermonters to get to and from work. Time and money spent commuting are not direct contributions to the productivity of the economy, but are an expense that workers must endure in order to get to work and be productive. As an expense, it ought to be deducted from the economy's bottom line. GPI deducts direct commuting expenses—fuel, depreciation on vehicles, transit fares—and also indirect expenses—the opportunity cost of the time spent commuting. Recognizing that for many people the daily commute has value as a private time, or that it is otherwise enjoyable or productive, standard GPI methodology adjusts the hours lost to commuting downward to 65% of the reported figure.

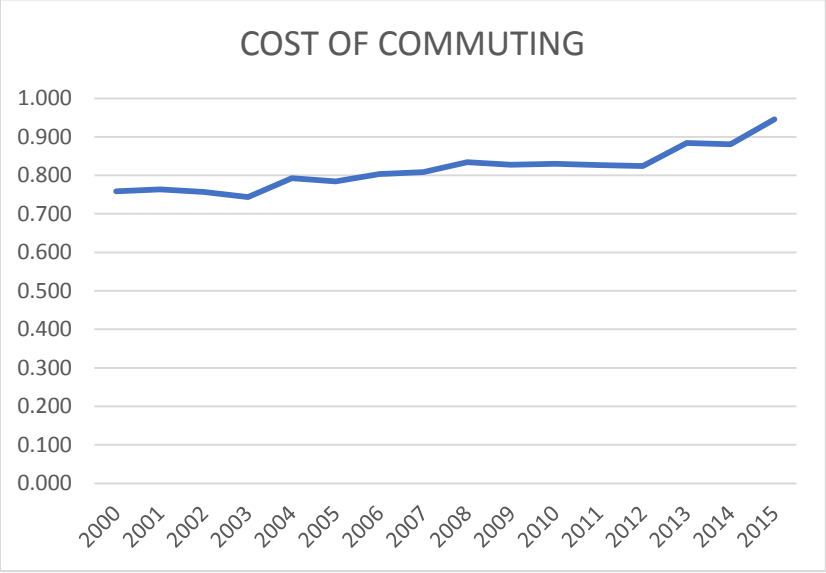

Figure 38: Cost of Commuting, in billions of year 2015 dollars.

The Cost of Commuting varies with several factors, the price of fuel and the average time of commute being two of the most influential. In 2015 the Cost of Commuting rose by 7.3%, from $881 million in 2014 to $946 million. The most significant contributing factor was an increase in the total number of hours spent commuting, which rose from 61.4 million hours to 64.1 million hours. Sixty-five percent of those hours, valued at the average Vermont wage of $22.10 per hour, added up to $617 million in 2014 and $662 million in 2015—a 7.2% increase.

Additional research would be needed to determine whether Vermonters commuted longer distances, on average, in 2015 than 2014, or whether the longer hours were due to congestion, construction, or weather.

24. Cost of Motor Vehicle Crashes

The economist Frederick Bastiat named the Broken Window Fallacy in 1850 (see p. 16). Had he named it more recently, he might have called it the Smashed Fender Fallacy. Accidents cost money, and the money spent to repair the damage from them can at casual glance seem to be a stimulus to the economy. And that's how GDP treats them: the damaged property and human pain, suffering and fatalities from motor vehicle accidents look beneficial under GDP, because they lead to spending on collision repair, medical expenses, and (we have to include) funeral expenses. But accident repair and emergency medical expenses are remedial expenses, not a fresh contribution to the stock of valuable goods the economy has produced, and funeral expenses for a fatality are a regrettable expense, not a welcome one. Properly, then, the cost of motor vehicle crashes ought to be deducted from the bottom line.

This indicator uses Vermont-specific data for the number of automobile accidents that result in property damage, injuries, and fatalities, and uses cost and valuation data from national data sets to place a cost on each. According to the National Safety Council's calculations done in 2010, the average cost in property damage per accident was $9,626 in year 2015 dollars.[68] (That number is used here, though it probably under-represents the actual number, as vehicles have become more complex with increasingly valuable technologies that are easily damaged in accidents.)

Figures for average cost of injury and average cost of traffic fatality also come from National Safety Council studies, as shown in Table 6. These figures are for those expenses that are readily counted in monetary terms: wage and productivity losses, medical expenses, administrative expenses, motor vehicle damage, and employers' insurance costs. The values given are for each injury or death, not for each injury- or fatality-producing crash. The NSC offers other, considerably higher figures that include monetary sums for lost quality of life; per death that

Type of accident by injury severity	Cost
Death	$1,542,000
Disabling	$90,000
Evident	$26,000
Possible	$21,400
No injury observed	$11,400
Property damage only (cost per vehicle)	$4,200

Table 6: National Safety Council figures for cost of various types of accidents, in year 2015 dollars

[68] National Safety Council, "Estimating the Cost of Unintentional Injuries, 2015," accessed at http://www.nsc.org/NSCDocuments_Corporate/estimating-costs.pdf

amount is $10,082,000. The lower figure is used in these GPI calculations, which means that the Cost of Motor Vehicle Accidents given here is a very conservative estimate.

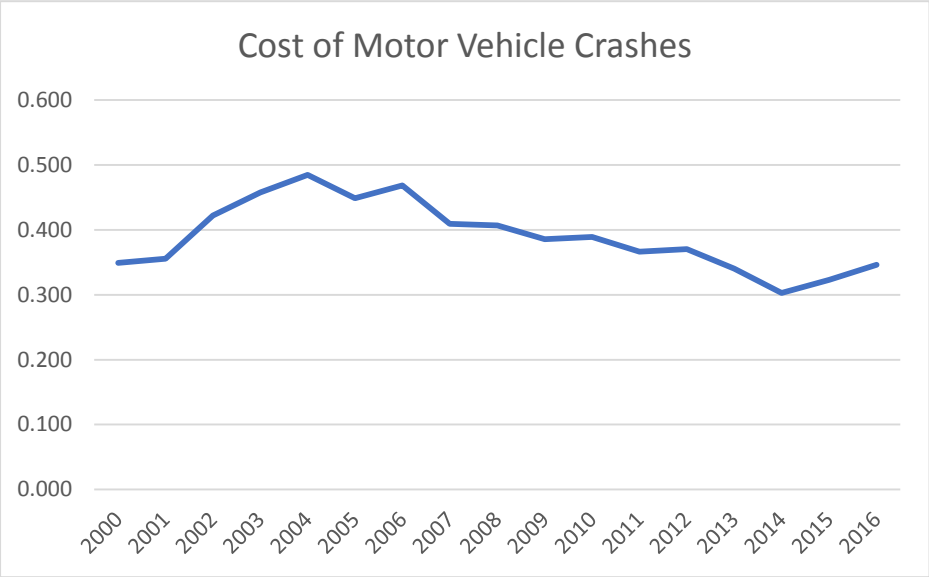

Figure 39: Cost of Vermont's Motor Vehicle Crashes, in billions of year 2015 dollars

As Figure 41 shows, the Cost of Motor Vehicle Accidents in Vermont declined steadily from a peak in 2004 until experiencing an upturn from 2014 to 2015. Fatalities went from 44 in 2014 to 57 in 2015, nearly a thirty percent jump. In the peak-cost year of 2004, there were 98 highway fatalities in the state.

Chapter Five

The Future of Vermont GPI Work

Past GPI studies have been issued through the Gund Institute for Ecological Economics, as was specifically directed by Act 113, the enabling legislation for the GPI (see Appendix 4). Reorganization of the Institute has given it a new name—the Gund Institute for the Environment—and brought staffing changes. Under the new Institute's rules for such matters, the Coordinator of the Vermont Genuine Progress Indicator Project is no longer a Fellow of the Institute. This is why this year's study is being issued through the Vermont Data Center, which is part of the Center for Rural Studies at the University of Vermont, where the Coordinator of the project is now a Fellow.

Where the work will be housed in the future is not certain at this writing, and depends on several factors. Looming large among relevant considerations is the question of funding. In the past, work on the GPI has been minimally funded primarily through donations raised by those engaged in the work. Much of the work has been done *pro bono.* This will not continue.

The current method of funding the work has not been sufficient to allow for completion of forward tasks, such as implementing the significant conceptual and methodological changes that have been proposed for "GPI 2.0," described below.[69] Those changes have been endorsed by the GPI community of practice meeting as the National GPI in the States Technical Advisory Group. That group last met at UVM in 2014, in a conference supported by participation fees and outside funding; the proposals for GPI 2.0 emerged from that conference. To achieve comparability between state efforts and to support development of a shared GPI standard methodology, Act 113 specifically calls for the Vermont GPI to be compiled in a manner consistent with that of Maryland, which pioneered state supported compilation of the indicator. Maryland has moved to adopt the 2.0 methodology. The Vermont GPI Project has

[69] Kenneth J. Bagstad, Günseli Berik and Erica J. Brown Gaddis, 'Methodological Developments in US State-Level Genuine Progress Indicators: Toward GPI 2.0', *Ecological Indicators*, 45 (2014), 474–85 <https://doi.org/10.1016/j.ecolind.2014.05.005>.

not had the resources—the staff time, the financial support—to allow it to implement the new methodology.

Briefly summarized, the changes that GPI 2.0 would implement are:

- Substituting Household Consumption Expenditures for Personal Consumption Expenditures as the more relevant indicator of material wellbeing;
- Deduction of Household Defensive Expenditures from Household Consumption Expenditures, including money spent on insurance, medical care, and legal expenses;
- Deduction of money spent on "welfare neutral" commodities such as tobacco and 25% of alcohol;
- Use of more sophisticated formulae for correcting Household Consumption Expenditures for income inequality;[70]
- Inclusion of new indicators for biomes that are common in other states: on- and off-shore marine environments, grassland/savannah, desert;
- Inclusion of a measure of the cost of water insecurity, water scarcity, and drought;
- Expansion of the measure of the Cost of Air Pollution to include all pollutants indexed and reported by the E.P.A.;
- Inclusion of the cost of severe weather events as part of the Cost of Climate Change;
- Expansion of Service Value of Streets and Highways to become Service Value of Public Infrastructure, which would include the service value of parks, schools, recreational facilities, performance spaces, and the like;[71]
- Inclusion of the Cost of Risks associated with hosting various parts of the nuclear power industry, from fuel processing to waste storage;
- Realignment of several existing indicators into a new category, "Social Costs of Economic Activity," which would include a new tally for Cost of Homelessness.

Behind these changes is a major conceptual change in how the indicator is compiled. Currently, GPI deducts as a cost any diminishment of ecosystem services that we enjoy; this is the logic behind putting a price on the net change in the various biomes that are included in the measure. The new methodology proposes to count the ecosystem service value of those biomes as a positive contribution to GPI's bottom line instead of counting their interruption and removal as a cost. Their interruption and removal would continue to show up in the accounting as a loss, but the conceptual shift is significant: it makes the point that the Economy of Nature (if we may call it that) is the larger entity, the host-ground within which the Economy of Humans operates.

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[70] The 2.0 methodology looks at the marginal utility of income across various income brackets, as analyzed by Layard, R., Nickell, S., and Mayraz, G. 2008. "The marginal utility of income." *Journal of Public Economics* 92 (2008) 1846–1857. <http://darp.lse.ac.uk/papersdb/Layard_etal_(JPubEcon08).pdf> For detail on the proposed change, see Appendix One.

[71] The Maryland GPI's 2.0 version includes a category of "Public Provision" that indexes contributions to well-being made by expenditures by state and local governments and by non-profits. The category includes transfer payments (family assistance, unemployment compensation), funding for small businesses, and other investment items.

By extension, GPI 2.0 would also count the service value of Human Capital (the education, training, and experience that we have that contributes to our ability to produce economic wellbeing) and Social Capital (which is where the value of Leisure Time and Domestic Production are tallied, and which also includes the service value of internet access). Downward movement in these indicators counts as a loss, i.e. a cost.

There are other changes not specifically called for in the GPI 2.0 proposal that would improve the utility of GPI as a policy tool by sharpening the metric and in some cases making it more state-specific. Those changes include:

- Using Geographic Information Systems data to measure changes in the various biomes that are included in the GPI calculations;
- Using Geographic Information Systems data and other data to sharpen the measure of the service value of particular biomes by including such factors as
    - Flood-absorption capacity of riparian farmland
    - Species-sustaining value of corridor forests that link habitat areas;
- Recognizing under Cost of Net Change in Farmland that organic farmland and non-organic farmland have different ecosystem service values—and different valuations in the market based on different levels of economic productivity;
- Recognizing that a measure of the sheer acreage of farmland doesn't capture changes in soil fertility, i.e. recognizing that "soil mining"—the extraction of soil fertility for commercial sale as produce—degrades the service value of farmland without affecting its total acreage;
- Using real-time data for longevity of service for consumer durables, with the data being collected through reports at time of sale and disposal, or through passive reading of chips embedded in such goods;
- Finding some non-proxy way to measure noise pollution in Vermont, perhaps by using survey research sampling methods, perhaps by using data generated from twitter users, as has been done by a research team at UVM to gauge levels of happiness;[72]
- Recognizing that being paid a symbolic honorarium should not disqualify one from being counted as a volunteer (a change that would increase the measure of volunteerism by allowing inclusion of many town officials and some school officials, like unpaid coaches, in the count).

All of these changes would require "back-casting" of the data set to retain comparability within the state GPI over a period of years. Some of the data needed to implement GPI 2.0 reach back only to 2012, so in the short run comparison across years would be limited. This work is not cost-free and cannot be accomplished under the current funding model.

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[72] Dodds PS, Harris KD, Kloumann IM, Bliss CA, Danforth CM (2011) Temporal Patterns of Happiness and Information in a Global Social Network: Hedonometrics and Twitter. PLoS ONE 6(12): e26752. https://doi.org/10.1371/journal.pone.0026752

Chapter Six

Conclusions, Recommendations, and a Few Final Words

Conclusions

Vermont's Genuine Economy, as measured by the Genuine Progress Indicator, is among the healthiest of state economies in the country—but this is faint praise. Vermont has the sixteenth-smallest gap between its Gross State Product and its GPI. That gap can be taken as a (very) rough measure of success in the effort to keep the social, environmental, and economic costs of the economy to a minimum. At 34% of the GPI the gap is significant and should be a cause for concern.

As noted in the text discussing the Cost of Non-Renewable Energy Resource Depletion, GPI aims to be a measure of net economic welfare, but is not by any means an approximation of net *sustainable* economic welfare. One ready gauge of the degree to which the Vermont economy is sustainable can be found in some of the data that GPI collates: the percentage of energy moving through the Vermont economy that is sustainably sourced and sustainably sunk. For 2017 in Vermont that percentage was 24.9%, placing Vermont eighth among all states and the District of Columbia. (see p. 35)

Another finding from the GPI deserves emphasis: the 2015 GPI shows the positive effects of the state's commitment to develop solar and renewable energy. The Cost of Non-Renewable Energy Resource Depletion, the second-largest cost item in the GPI, fell by $0.2 billion (3.7%) for the year, as Vermonters continued to wean themselves from fossil fuels.

Personal Consumption Expenditure continues to be the dominant factor in GPI compilations, Vermont's included. The 2015 figure of $29.8 billion (as reported in Table 1) comprises 146% of the final GPI tally. The dominance of PCE in the metric is problematic, for changes in PCE are not especially indicative of the condition of the Genuine Economy. PCE tends to increase or decrease in step with GSP—the flawed metric that GPI seeks to correct.

A better gauge of the dynamic health of Vermont's Genuine Economy is the ratio between percentage change in PCE and percentage change in GPI. Between 2014 and 2015, PCE went up by 1.6%, while GPI went up by 7.0%. As a matter of logic, this gratifying result can trace to either or both of two circumstances: either environmental and other cost items in the GPI did not rise in tandem with PCE (suggesting that the economy became more environmentally efficient—the environmental cost per unit of consumption declined) or the non-market benefits tallied by GPI grew more rapidly than did Vermonters' consumption expenditures. Each of these, in turn, has various possible causes.

For the first: the failure of environmental and other costs to rise as rapidly as PCE could be due to:

- A shift in consumption to lower-footprint goods and services;
- An increase in the export of Vermonters' consumption footprint to other states and countries;
- Success in reducing the environmental costs of the economy, as when renewable energy replaces fossil-fuel energy, reducing the charge for Cost of Non-Renewable Energy Resource Depletion;
- Success in reducing the net of non-environmental costs charged against the Vermont economy (Income Inequality, Underemployment, Crime, Motor Vehicle Crashes, Family Changes, Lost Leisure, Commuting).

Of these four possible sources of improvement in the ratio of GPI to PCE, only the latter two can be tested under current GPI methodology.[73] Environmental costs did indeed fall, by $0.18 billion. But this positive change was more than offset by a negative change, an increase in the net of non-environmental costs of $0.75 billion. Thus, the total effect of this category of dynamic cause amounted to a net of $0.57 billion increase in costs.

This means that the improvement in the ratio of GPI to PCE came from the other categories of possible causes. Some of the non-market benefits that GPI assesses rose more rapidly than PCE, helping to account for the discrepancy in growth rates between GPI and PCE. While PCE rose by 1.6% between 2014 and 2015, the Value of Domestic Production (comprising 28.1% of the GPI)

[73] The problem of exported environmental costs is one that the National GPI in the States Technical Advisory Committee is aware of. While not specifically addressed in GPI 2.0, the matter is under consideration. The basic question: should GPI methodology charge environmental costs where they are incurred (i.e. in production), or should it charge environmental costs against the consumers of the things produced? Current methodology goes with the first; there are strong arguments for changing to the second, though the data that would enable this are neither full nor readily available.

rose by 9.1%, adding $0.46 billion to the bottom line. The Value of Education also rose, by $0.28 billion (5.8%). Another riser was the Service Value of Streets and Highways, which added a $0.15 billion improvement to the bottom line. Altogether these three positive changes in benefits, totaling $0.89 billion, exceed the net increase in costs by $0.32 billion, accounting for much of the favorable disparity between rates of increase in GPI and PCE. The remainder of the disparity is most likely due to the first two listed causes—the causes that can't be isolated under current methodology.

The largest negative item in the GPI continues to be the adjustment for income inequality, which continued to rise, increasing 5.4% to $6.48 billion in 2015. While some of the dynamics that produce this rising income inequality are national in scope, and thus lie beyond the reach of state policy, nevertheless there are state-level policies that could mitigate the effects of those national dynamics. A 2014 study of the GPI effects of enacting a proposed minimum wage hike in Maryland found that increasing that wage from $7.25 to $10.10 per hour would bring an increase of more than $2 billion a year to the state's GPI. While the positive effects would show in many categories (including increased consumer spending, reduced underemployment, reduced crime and increased service value of consumer durables in low-income households), half of the gains were predicted to come from the increased wage's effects on income distribution in the state. Using state income and employment data, Talberth found that the minimum wage increase would lower the state's Gini Coefficient (the basic measure of income inequality used in the GPI calculation) from 0.4470 to 0.4440, yielding a gain in the GPI of $1.016 billion per year, as Maryland's Income Inequality Adjustment would fall from $42.87 billion to $41.85 billion.[74] An equivalent percentage change in Vermont's Gini Coefficient would produce an increase of about $310 million per year in Vermont's much smaller GPI. To that must be added the knock-on effects, which, if they were to match the proportion that Talberth's analysis postulates for Maryland, would double that positive change in the GPI to $620 million, a 1.5% gain in the GPI.

A larger hike in the minimum wage would have a correspondingly larger impact on the GPI.

[74] Talberth, John, "Legislative Impacts on the State's Genuine Progress Indicator for HB 295: Maryland Wage Act of 2014," Center for Sustainable Economy, accessed at https://sustainable-economy.org/wp-content/uploads/2014/06/GPI-Note-Minimum-Wage-Act-of-2014.pdf

Recommendations

In 2015, Vermont became the first state ever to set an economic development goal in terms of the GPI. The goal was articulated in the state's Comprehensive Economic Development Strategy (or CEDS) produced that year:

> this CEDs sets out a unique, overarching goal: It proposes to not only grow jobs and wages and increase our Gross Domestic Product, but also to improve the Genuine Progress Indicator, (GPI)—a measure that takes into account economic, social and natural assets and impacts—by 5% over baseline over the next five years.[75]

Given the foregoing GPI analysis, it isn't difficult to derive broad-gauged policy recommendations that would serve that goal.

As noted, the two largest deductions against the GPI accounts are the adjustment for Income Inequality and the charge for Cost of Non-Renewable Energy Resource Depletion, at $6.48 billion and $5.20 billion, respectively. The next largest deduction in the accounts is for Cost of Water Pollution, at $2.10 billion—one-third of the adjustment for Income Inequality. Given the outsized influence that income inequality and fossil fuel use have on the GPI, it seems likely that policies that aim to decrease those two costs offer the greatest "bang for the buck"—the greatest return on policy investment. And, given the certainty that the GPI's charge for Water Pollution undervalues the knock-on (or multiplier) effects of waterbody clean-up (see Appendix 3), policy attention to solving the state's perennial algal bloom problem in its major lakes is likely also to have a large payoff in the GPI accounts.

Thus, while any policy directed to reducing a cost or increasing a benefit measured by GPI will of course have a positive effect on the GPI, and might in any case be pursued on its own merits, three policy implications stand out as being likely to offer the largest opportunity for positive change in the GPI:

1. **The state should continue to make progress toward the carbon-reduction goals offered in the Comprehensive Energy Plan (90% reduction by 2050).**
2. **The state should implement policies (such as "living wage" legislation) that would begin to reduce the level of income inequality produced within the Vermont economy.**
3. **The state should energetically pursue the clean-up of its most contaminated waterbodies, including especially Lake Champlain.**

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[75] Vermont Agency of Commerce and Community Development, "Vermont 2020: Comprehensive Economic Development Strategy," accessed at http://accd.vermont.gov/sites/accdnew/files/documents/DED/CEDS/CEDS2020FullReport.pdf

The foregoing GPI analysis not only offers some clear implications for policy making, it also offers clear implications for improving the GPI as a policy tool. Some recommended improvements have been discussed in the sections on individual indicators and in Chapter Five and need not be repeated here. All of them depend on one overarching recommendation:

The Vermont Genuine Progress Indicator Project should be given a secure source of funding, so that appropriate staffing can accomplish both the regular compilation of the indicator set and make progress on various forward tasks.

Those forward tasks include

- incorporating the changes called for by GPI 2.0;
- designing, implementing, and advocating for other changes in the indicator set that will improve its utility as a policy tool;
- corresponding and otherwise connecting with GPI compilers in other states to work for continued comparability among state GPI estimates;
- establishing liaisons with various state agencies whose work involves generation of data relevant to the GPI compilation, or whose work would benefit from use of GPI data in program evaluation; and
- dissemination of information about the theory, practice, and utility of the GPI to policymakers, media and the general public.

In the first of the GPI reports made to the state by the Vermont GPI Project, authors Erickson, Zencey, Zimmerman et al. called for four specific improvements to the GPI compilation. Their recommendations, made in 2013, bear repetition in 2018. The GPI Project needs to find, purchase, or otherwise develop:

1. **Vermont-specific data** sets to replace variables that predominantly use national data;
2. **Values for environmental variables** that can be adjusted by geographic context;
3. **Time use data** for social variables to account for Vermont differences from national trends; and
4. A joint strategy with other GPI states on the development and implementation of new methods leading to a **new GPI standard**.

Beyond improvements within the GPI, that 2013 report also called for other developments that would increase the GPI's direct applicability to policy. Two of those recommendations are especially relevant today:

1. Application to **outcomes-based budgeting** through the use of complementary population-level indicators incorporated into GPI, such as education levels, volunteer rates, crime, public transit, and other social statistics;

2. Creation of a **GPI note**, analogous to a fiscal note, to assess the impact of legislation on the 25 components of GPI.[76]

To those two recommendations can be added a third:

3. Explore the possibilities of compiling the GPI at a sub-state level, specifically at the level of the nine Act 250 Districts, and explore the interplay between GPI indicators and Act 250 criteria.

This latter recommendation is an invitation to explore an hypothesis: it seems likely that Act 250 regulations encode values that are supported by GPI indicators and vice versa. Integration of the two might lead to swifter, clearer, less controversial decision-making by District Commissions, while demonstrating on a very practical level how the GPI indicator set can integrate with the effort to preserve Vermont's environmental values while accommodating changes in economic activity in the state.

A Few Final Words

In summary, and in the words of John Talberth from the recent national GPI study, the GPI has the potential to become a "headline indicator for the new economy" – an economy that takes as its reason for being the continual increase in human quality of life rather than a perpetual increase in both the commotion of money and the throughput of resources.

Further development of the GPI and its greater integration into policymaking can help reinforce Vermont's unusual and common-sense approach to economic development, as embodied in Act 250 and associated rule-making. Widespread appreciation and use of the GPI may even work to shift the fundamental philosophy of economic development that prevails in much of the country today, moving it away from the infinite-planet thinking that leads us to press hard against the non-negotiable limits of the natural systems that are the true foundation of our wellbeing and of our civilization.

The GDP-denominated growth economy has been focused on short-term profits, with the goal of processing resources as prolifically and as quickly as possible, with little to no regard for the actual level of general welfare or economic wellbeing that its frantic use of resources creates. In contrast, the genuine economy is focused on generating long-term value, with the goal of sustaining profits, people and planetary systems. The conventional growth model encourages the depletion of non-renewable resources and externalization of costs—costs that are

[76] One example of such a GPI note is a previously cited work by John Talberth, "Legislative Impacts on the State's Genuine Progress Indicator for HB 295: Maryland Wage Act of 2014," Center for Sustainable Economy, accessed at https://sustainable-economy.org/wp-content/uploads/2014/06/GPI-Note-Minimum-Wage-Act-of-2014.pdf

unmeasured by GPI, costs that fall on the less powerful at home and on people in distant lands and distant futures. Genuine progress occurs through substituting renewable for non-renewable resources and through internalizing the full cost of economic activity into the price of the products of that activity. Without that internalization, markets cannot be efficient allocators of resources between competing uses. GPI is one mechanism for counting those costs and internalizing them into its measure of the economy as a whole. Policy guided by GPI will work to internalize costs at the micro-economic level.

"Progress" can no longer simply mean expanding the human footprint on the planet. Nor can it continue to mean squeezing every last waking hour out of labor until workers are tired, sick, demoralized and in need of replacement by the next in line. Progress is ultimately movement toward establishing a healthy balance between planet and economy, and between work, family, community, and leisure, giving us the time, space, and natural and economic wherewithal to enjoy the benefits of a standard of living that is widely and equitably shared. To achieve this, we must understand that progress also consists in preserving and strengthening the two kinds of capital—natural and social—that our GDP-denominated economy has completely ignored in its accounting system, allowing them to be used and used up as though they were for all practical purposes infinite. GDP is an infinite-planet economic indicator; GPI is its finite-planet replacement.

We have it in our power to make real the vision of an economy adapted to a finite planet, operated in service to increasing our human standard of living while remaining firmly within nature's physical limits. Central to that effort will be the continued compilation, improvement and policy use of the Genuine Progress Indicator.

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Appendices

Appendix One: Measuring Income Inequality

Vermont is justifiably proud of its tradition of town meeting, where citizens meet as equals to decide budgets and other policy matters for their polity. Behind that political equality is a deeper kind of cultural and social equality that allows Vermonters to live and work together in both freedom and unity, as the state motto puts it. That cultural and social equality is sorely strained by economic inequality--large disparities in the distribution of income and wealth. And those disparities have immediate, and negative, political consequences as well. As FDR's vice president Henry Wallace once observed, "Men and women cannot be really free until they have plenty to eat, and time and ability to read and think and talk things over." In the face of radical disparities in income distribution, democracy becomes endangered.

Not only does income inequality corrode the foundations of democracy, it impedes the achievement of other worthy policy goals. Scott Remer, in an essay titled "Mind the Gap: the Danger of Income Inequality," reports that "Citizens of more highly stratified societies suffer from increased status anxiety, stress, and mental illness. More unequal societies have higher rates of violence, addiction, teenage pregnancy, obesity, and imprisonment."[77] Reductions in each of these rates is a worthy goal of policy--each on their own merit as wise statecraft, but also in sheer practical terms because those reductions would ultimately save taxpayers money. While none of these social problems traces solely to income inequality, mitigating that inequality is certain to have a beneficial effect on them.

As noted in the text of this report, state GPI compilations use the state Gini coefficient as their measure of income inequality. This is one area that may see methodological changes in the future.

One possible change would be to incorporate into the compilation the average of two different GINI measures: what economists call the "Market Gini" (the Gini given by market forces that shape the compensation workers receive for the work) and the "Post Tax and Transfer Gini" (the Gini that measures income after taxes have been paid and after transfer payments, like Social Security, Unemployment, and other safety-net payments, have been made). As Figure 42 shows, the Ginis for pre-tax and post-tax incomes track closely with the Ginis for market income at a lower level, diminishing the market Gini by about a quarter. As Figure 43 shows, government transfers also affect the Gini coefficient. In 2011, transfers reduced the market Gini by 26%, which would mean a drop from 0.48 to 0.355.

[77] Scott Remer, "Mind the Gap: The Danger of Income Inequality," *The Politic,* Feb. 27, 2014, online at http://thepolitic.org/mind-the-gap-the-danger-of-income-inequality/

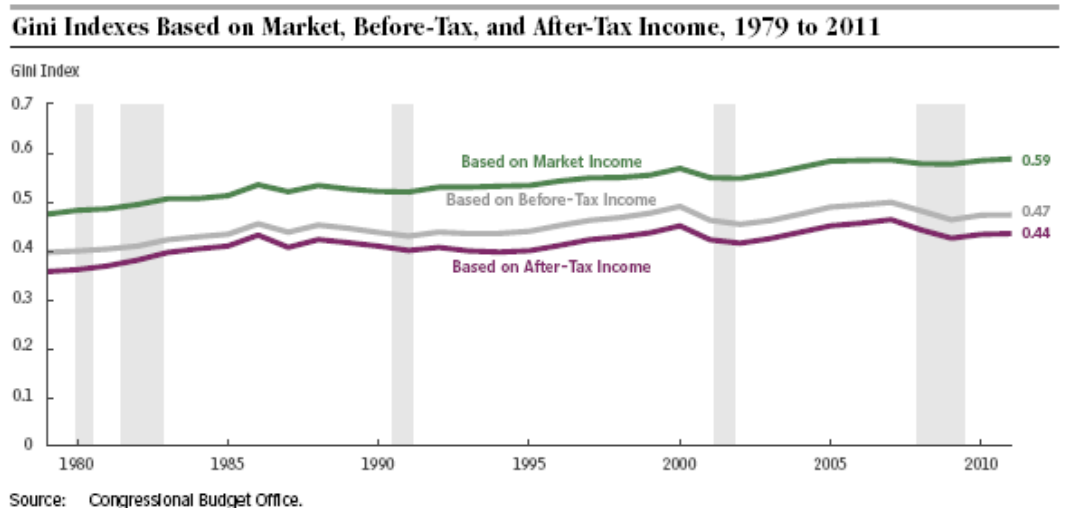

Figure 40: U.S. Gini Coefficients for market income, pre-tax income and post tax income.

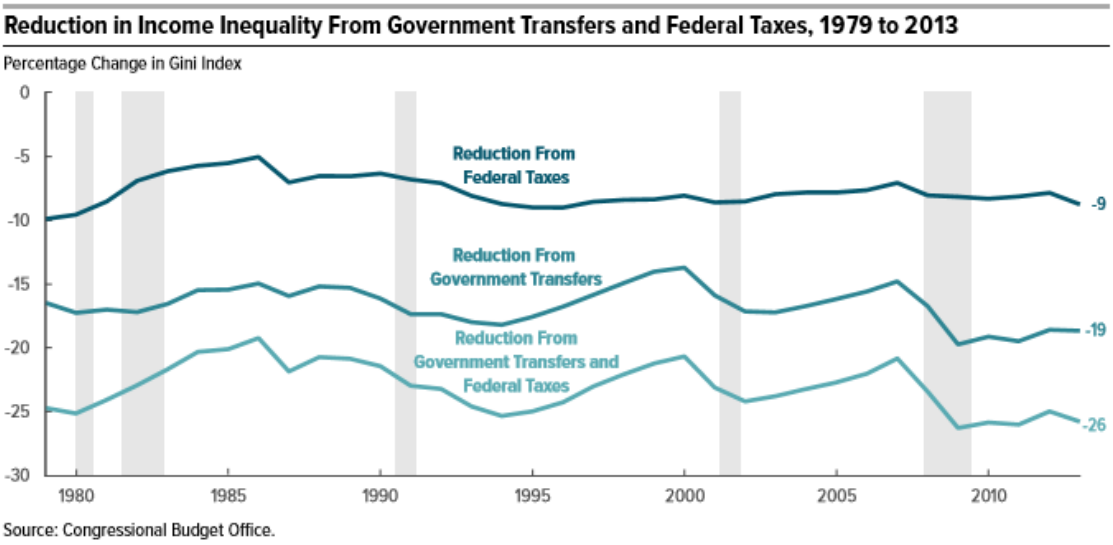

Figure 41: Percentage change in Gini coefficient attributable to the indicated policy action

The argument for using the Post Tax and Transfer Gini is that the indicator ought to measure the actual incomes people experience, whether the source of that income is remuneration achieved in the labor market or whether it has been augmented subsidy received outside of employment. And yet there are psychic costs associated with receiving non-labor remuneration--not so much, perhaps, for Social Security (which, as a form of social insurance, can be construed by the recipient as a just reward for a lifetime of work, and a form of insurance for which they've paid premiums), but for other forms of subsidy from public monies. Retention of some element of the Market Gini captures these structural costs of unequal

distribution of income by the market. Averaging the two Ginis, then, seems like a way to have both elements (the structural inequality of the economy, and our attempts to mitigate some part of the effects of that structural inequality through policy) represented in the indicator.

Including the Post Tax and Transfer Gini in the calculation has the advantage of offering state-level policy makers another policy lever by which to affect this component of the GPI. Legislation raising the minimum wage would affect the Market Gini, through intervention in market systems. Legislation securing the social safety net would affect the Post Tax and Transfer Gini and raise GPI if this Gini were included in the calculation behind the compilation.

There are other innovations in the use of the Gini Coefficient that bear exploration and consideration by the group of state GPI practitioners who set the standard GPI methodology.

One such innovation is offered by World Bank economist Branko Milanovic. He argues that the upper limit of one in standard Gini measurements--the condition in which one person has all the income, and all others have nothing--is completely unrealistic, since those without income would die of starvation. More useful, he says, is to take as the upper limit of inequality a theoretical maximum in which all but one percent of the population has a bare subsistence level income. This distribution, Milanovic says, would be the "maximum feasible inequality" for a nation.

A level of income that supports a bare subsistence is a per capita measure: each person needs, at a minimum, income to cover food and some kind of shelter. This minimum doesn't vary even as the incomes of wealthier individuals rise or fall. Thus, the maximum feasible inequality rises with the total amount of income the economy produces.

A collection of points of maximum feasible inequality for different levels of income would, when charted, form an Inequality Possibility Frontier. At each level of total income it is possible to assess how close to that frontier the economy is operating. In 2013 Milanovic found that the U.S. economy was operating at 50% of its theoretical Maximum Feasible Inequality. In other words--words that are equally accurate but more troubling--in that year the U.S. was halfway to a condition in which 99% of Americans had a bare subsistence level of income.[78]

Milanovic proposes to call this ratio of actual to theoretically possible inequality the Inequality Extraction Ratio, or IER. It measures "how close...measured inequality [is] to the maximum inequality that can exist in a given society"--that is, society's maximum feasible inequality. It's derived in the same way as the Gini coefficient, but instead of using a floor of zero income for its lower bound, the floor is the income necessary for physiological subsistence.

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[78] Branko Milanovic, "The Inequality Possibility Frontier: Extensions and New Applications," Policy Research Working Paper 6449, The World Bank Development Research Group, Poverty and Inequality Team, May 2013. Accessed Jan. 14 from https://openknowledge.worldbank.org/bitstream/handle/10986/15589/WPS6449.pdf?sequence=1&isAllowed=y

Yet another approach to refining the income inequality adjustment in the GPI was offered by Michael Weisdorf in a working paper circulated to GPI compilers.[79] The proposal calls for applying the concept of diminishing marginal returns to income. As most economics textbooks instruct, as a person's consumption of a good or service increases, at some point each additional unit consumed brings less satisfaction than the previous unit. Few standard texts extend that insight to consumption as a whole, as represented by income, although research indicates that the Law of Diminishing Marginal Utility applies here as well.[80] When applied to income inequality calculations in the GPI, this acknowledgement of the Diminishing Marginal Utility of Income (DMUI) offers a more precise assessment of the reduction in economic benefit produced by income inequality and solves several additional problems as well. Standard GPI methodology measures the change in Gini Coefficients since 1970, the year that saw the lowest Gini in recent decades. Weisdorf's proposal would make use of a base year unnecessary. Instead, the norm against which income inequality is measured could be median income; or the Federally defined poverty level (or some multiple thereof); or the annual income implied by a living wage; or whatever research determines to be the annual income at which marginal increases begin to offer diminishing returns. (In 2010 Kahneman and Deaton found that in the U.S., subjectively reported well-being does not increase with increases in income beyond approximately $75,000 per person per year.[81] Before the marginal returns to increased income fall to zero they must begin diminishing at some point.)

Adoption of any of the adjustments to the GPI methodology outlined here would require staff time that is not currently available to the Project.

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[79] Michael Weisdorf, "The Genuine Progress Indicator: Adjusting for inequality in consumptinon ," GPI 2.0 Working Paper Series, Institute for Sustainable Solutions, Portland State University, April 2014.

[80] R. Layard, G. Mayraz, S. Nickell, "The marginal utility of income," *Journal of Public Economics* 92:8-9 (2008), pp. 1846-1857. Study of the relationship between consumer satisfaction and money income has led economics to the growing literature on subjective wellbeing (i.e. happiness) studies. See Ed Diener and Robert Biswas-Diener, "Will Money Increase Subjective Well-Being?", *Social Indicators Research* 57:2 (2002) pp. 119-169. The idea that increases in income have diminishing marginal returns is not without detractors. See R. A. Easterlin, "Diminishing marginal utility of income? Caveat Emptor," *Social Indicators Research* 70:3, 2005, pp. 243-255. Stevenson and Wolfers, in "Subjective Well-Being and Income: Is there any evidence of satiation?", answer their titular question with a firm "no": "if there is a satiation point, we have yet to reach it." (*American Economic Review* 103: 2, May 2013, pp. 598-604.)

[81] Daniel Kahneman and Angus Deaton, "High income improves evaluation of life but not emotional well-being," *Proceedings of the National Academy of Sciences* 107:38, September 2010, pp. 16,489-16,493.

Appendix Two: Valuing Clean Water in Vermont

There are any number of ways to value the clean-water assets of the state, with no single method recommending itself as definitive. Within the literature on GPI, the figure of $130 per person per year, in year 2000 dollars (which would be $179 in year 2015 dollars) echoes from study to study as the per capita value attached to clean waterbodies. The number traces to unspecified valuation efforts reported by the Maryland GPI—efforts that asked people how much they would spend to reduce or eliminate water pollution.[82]

Commendably grass-roots oriented as that method may be, it has numerous problems. People who make more money have more money to spend, and are therefore more likely to spend more money on any particular good they desire, including the public good of clean waterbodies; this means that the value of clean water to a community rises with the rising incomes and wealth of that community, and decreases with decreasing wealth and income. That result seems counterintuitive; we expect the value of water to be more stable than this method implies. In addition, this method makes the total dollar value of clean water in Vermont rise with population increase (a result that may or may not seem counterintuitive depending on how anthropocentric one's intuitions are).

The figure of $130 per person per year is generally recognized as being an exceedingly conservative estimate. At the other end of the scale is an entirely different approach. In some sense, a clean environment is part of the identity of Vermont and of the people who inhabit its landscapes. Since that identity is of near-infinite value to Vermonters, clean water, an integral part of that identity, would have a near-infinite value. (The most recent GPI report for Hawaii makes a similar point about the role clean fresh water plays for residents of that state, though the study ultimately accepts the widely used $130 per person per year valuation.)[83] It would be hard to accommodate a value of infinity in any system of ledger-keeping, and GPI understandably rejects that approach. And yet the concept of identity-valuation of clean waterbodies--the near-infinite valuation common to residents of Vermont, Hawai'i and no doubt at least a few other states--might be made practical through well-designed social research. One might, for instance, ask a representative sampling of Vermonters "how much would someone have to pay you to move from Vermont to a similar place with this difference: all the lakes and rivers are polluted?" That number, averaged among all Vermonters, is likely to be considerably more than $130 per year.

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[82] A brief description of the origin of the $130 figure is given in the spreadsheet for Maryland GPI 1.0, which can be downloaded from <http://dnr.maryland.gov/mdgpi/Pages/overview.aspx>

[83] Regina Ostergaard-Klem and Kirsten Olesen, *Environmental Council Annual Report: State of Hawai'i: Presenting the Genuine Progress Indicator Baseline, 2013,* p. 30. Accessed Dec. 28, 2017 at http://oeqc2.doh.hawaii.gov/EC_Reports/EC-Annual-Report-2013.pdf

The $130 figure is no longer used by Maryland in the calculation of its water pollution costs in its GPI. The enabling legislation for the GPI specifically directed that the Vermont GPI be calculated consistently with that of Maryland to ensure comparability, so it seems appropriate and justified to let go of that $130 figure in the current report. While previous GPI compilations in both states have used what has been called "the Vermont-Maryland Model" in recognition of the fact that the methodology evolved in close consultation between the two states, the shared commitment to that model has fallen by the wayside. Unfortunately, there has been no support for the level of staff work necessary to maintain that level of coordination between the two states.

Maryland now uses a replacement-cost valuation for water pollution, pegging the value of clean water to the monies spent by the state and by conservation groups to restore waterbodies to non-impaired status. This method was considered for this report, but was rejected as being flawed by a troublesome circularity: the value of clean water is what it costs to achieve it, so that achieving clean water is always worth the financial cost--but only just barely. Under the cost-of-cleanup valuation approach, there is literally neither gain nor loss to be had in the pursuit of clean water.

Another valuation method is suggested by different approach to assessing the replacement cost of water: what does potable water actually cost Vermonters when they purchase it? This method yields two dramatically different results. According the U.S. Geological Survey, in 2010 (the last year for which the data is published) 342,630 Vermonters received their water from public supplies of either groundwater or surface waters, and they used a total of 13.96 million gallons a day (mgd).[84] The American Water Works Association reports that the national average cost per unit for potable tap water is $.004 per gallon; at that rate, 13.96 mgd works out to $.558 million a day in value. That yields an annual per capita average value of potable water in Vermont of $584.81 ($.558 million times 365 divided by the Vermont population). It seems sensible to round this figure to $600 per person per year to avoid suggesting specious precision. With that rounding, and on the assumption that aquifers from which public water is drawn are connected to above-ground waterbodies, the total value of clean waterbodies in Vermont is $360 million a year.

But "replacement value" might be something other than the per-gallon cost of public utility tap water: it could be taken to be what it costs to replace tap water that is polluted, as some residents of Bennington have had to do lately and as other Vermonters have had to do on occasion. Walmart currently sells bottled water for $.88 per gallon. Using this figure, the per capita value of a clean public water supply is $13,084 per Vermonter per year, or $7.8 trillion per year.

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[84]Retrieved 12/28/17 from https://waterdata.usgs.gov/vt/nwis/water_use?format=html_table&rdb_compression=file&wu_area=State+Total&wu_year=ALL&wu_category=PS%2CDO%2CCO&wu_category_nms=Public%2BSupply%252CDomestic%252CCommercial

Faced with estimates that are defensible but decidedly divergent, this study proposes that the valuation of clean water in the state--the measure from which pollution costs are calculated--should be taken as the average of these two figures, or $6,842 per person per year. That is the valuation that lies behind the Cost of Water Pollution figures given in this report.

A final word on Cost of Water Pollution: The numbers used here reflect only the value of potable water and are founded on the reasonable assumption that ground waters and surface waters are linked. Given this approach, the valuation used here does *not* include many of the other economically valuable services that waterbodies provide, among them fishing, boating, swimming, aesthetic and scenic values, and the increase in property valuations (and hence increased town income or reduced tax rates) that come from a property's being located on, near, or in view of a waterbody that can support these activities. Studies have been done that estimate these values in deriving a total value of Lake Champlain to the Vermont economy.[85] In 2016 Voigt et al. found that a one-meter decrease in clarity of water in Lake Champlain during the months of July and August "would lead to the loss of 195 full-time equivalent jobs, a $12.6 reduction in tourism expenditures and a total economic reduction of nearly $16.8 million."[86] The knock-on or multiplier effects of lake-related spending are considerable: "every dollar of lake-related tourism activity generates an additional $0.57 in labor income alone, $0.62 in other value added (taxes, property income, profits), and altogether an additional $0.60 in total output in the region." These multiplier effects mean that improvements in water quality will have positive GPI effects (through Personal Consumption Expenditures) beyond the solitary indicator for Cost of Water Pollution. A more detailed accounting of the Costs of Water Pollution—one that scored values beyond potability, as is suggested in the studies cited here and as is suggested in the GPI 2.0 methodology--would amplify the GPI effect of clean water policy even more.

[85] See Julia Decerega, Oscar Guerra and David Tramonte, "The Value of Lake Champlain: An Economic and Environmental Analysis," Policy Research Shop Policy Brief 1516-01, February 2016, The Center for Public Policy and the Social Sciences, Dartmouth College, Hanover, New Hampshire; and Brian Voigt, Julia Lees, and Jon Erickson, "An Assessment of the Economic Value of Clean Water in Lake Champlain," Technical Report No. 81, Lake Champlain Basin Program, Burlington, Vermont, September 2015.
[86] Voigt et al., op. cit., p. 34.

Appendix Three: The Broken Window Fallacy

Does restoration and repair of damaged wealth constitute a net gain in benefit? GDP, when used as a measure of wellbeing, assumes so, even though the clear, brief, simplest answer is "no." Ideally remediation and repair work should not be counted in the economy's bottom line. GPI excludes much of that expenditure by excluding government spending from its system of accounting, for much government spending is defensive or remedial in nature. (Government spending that isn't tends to increase Personal Consumption, which is the figure with which the GPI compilation starts.)

Some defensive and remedial expenditures remain in the GPI account, as the methodology doesn't exclude money spent on preventative health care, legal services (other than divorce costs), household security, stormwater fees, purchases of bottled water, home air filtration systems, and insurance. The GPI 2.0 proposes to include such deductions. People also spend money out-of-pocket to repair their property in the wake of damage from storms and other natural disasters. An adjustment for this is also called for in the implementation of GPI 2.0, through the creation of a metric for "Cost of Unusual Weather Events" that would subsume the existing metric for Cost of Climate Change.

A slightly different question is whether renovation and repair work like that done in Vermont after Tropical Storm Irene constitutes a net benefit for the state. The answer to that question has complexities that were best reserved to an appendix.

It's true that if significant money for renovation and repair comes from out of state through Federal subsidy, there may be a modest net gain to economic the wellbeing of state residents in the wake of a natural disaster. If the money is from an increased Federal deficit, the boost to the state economy is simply the normal boost to economic activity one would expect from Federal deficit spending—though a significant part of the boost is taken up with simple replacement of wealth—property and infrastructure—that was damaged. If that amount is deducted, what is left is the multiplier effect of the deficit spending.

If Federal deficit-produced dollars enter the state, and if the economy has significant underemployed resources (a high unemployment rate, for instance), then the "broken window" opportunity cost is reduced; the influx of outside money puts idle workers to work and since it was deficit-created its presence in the state doesn't require that economic activity be de-stimulated elsewhere. There would, however, be opportunity costs from the use of scarce natural resources. All the fossil fuel used to repair roadways, to shift detritus, to repair housing and so forth in the wake of Irene is fossil fuel that could have been used to accomplish other, forward looking, non-remedial tasks, such as building the machinery and equipment needed to harvest the planet's current solar income (i.e. renewable energy). Against that opportunity cost

must be set the reduction in opportunity cost produced by the economic stimulation that put idle resources back to work.

If the influx of Federal dollars is revenue-neutral within the Federal system--i.e., if taxes in other states are raised to pay for the repairs--then other things being equal whatever net gain the stricken state realizes is simply the sum of lost economic activity in other states, whose taxpayers pay the opportunity cost of the remediation expense through increased taxes, which reduce their disposable income and hence their Personal Consumption Expenditures.

Another qualification: if the rebuilding effort brings significant upgrades to the condition and productivity of replaced capital stock through modernization and design improvement, the expense is not solely remedial but is also in part new capital investment, and the long-term net effect of that investment may be positive.

Appendix Four: Vermont Act 113

Vermont Act 113 – An act relating to the genuine progress indicator

It is hereby enacted by the General Assembly of the State of Vermont:

Sec. 1. PURPOSE, DEFINITION, AND INTENT
(a) Purpose. The purpose of the genuine progress indicator ("GPI") is to measure the state of Vermont's economic, environmental, and societal well-being as a supplement to the measurement derived from the gross state product and other existing statistical measurements.

(b) Definition. The GPI is an estimate of the net contributions of economic activity to the well-being and long-term prosperity of our state's citizens, calculated through adjustments to gross state product that account for positive and negative economic, environmental, and social attributes of economic development.

(c) Intent. It is the intent of the general assembly that once established and tested, the GPI will assist state government in decision-making by providing an additional basis for budgetary decisions, including outcomes-based budgeting; by measuring progress in the application of policy and programs; and by serving as a tool to identify public policy priorities, including other measures such as human rights.

Sec. 2. GENUINE PROGRESS INDICATOR
(a) Establishment; maintenance.
(1) The secretary of administration shall negotiate and enter into a memorandum of understanding with the Gund Institute for Ecological Economics of the University of Vermont (the "Gund Institute") to work in collaboration to establish and test a genuine progress indicator (GPI). The memorandum shall provide the process by which the GPI is established and, once tested, how and by whom the GPI shall be maintained and updated. The memorandum shall further provide that in the establishment of the GPI, the secretary of administration, in collaboration with the Gund Institute, shall create a Vermont data committee made up of individuals with relevant expertise to inventory existing datasets and to make recommendations that may be useful to all data users in Vermont's state government, nonprofit organizations, and businesses.

(2) The GPI shall use standard genuine progress indicator methodology and additional factors to enhance the indicator, which shall be adjusted periodically as relevant and necessary.

(b) Accessibility. Once established, the GPI and its underlying datasets that are submitted by the Gund Institute to the secretary of administration shall be posted on the state of Vermont website.

(c) Updating data. The secretary of administration shall cooperate in providing data as necessary in order to update and maintain the GPI.

Sec. 3. PROGRESS REPORTS
By January 15, 2013 and once every other year thereafter, the secretary of administration shall report to the house committees on government operations and on commerce and economic development and the senate committees on government operations and on economic development, housing, and general affairs a progress report regarding the maintenance, including the cost of maintenance, and usefulness of the GPI.

Sec. 4. DATASETS
Any datasets submitted to the secretary of administration pursuant to this act shall be considered a public record under chapter 5 of Title 1.

Sec. 5. EFFECTIVE DATE
This act shall take effect on passage.

Approved: May 8, 2012