The economic value of investing in Colorado's future workforce

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COLORADO SUCCEEDS
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Policy Roundtable

COLORADO CONCERN

DENVERSOUTH
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About the REMI Partnership

A partnership of public and private organizations announced in July 2013 the formation of a collaboration to provide Colorado lawmakers, policy makers, business leaders, and citizens, with greater insight into the economic impact of public policy decisions that face the state and surrounding regions. The parties involved include the Colorado Association of REALTORS®, the Colorado Bankers Association, Colorado Concern, Common Sense Policy Roundtable and Denver South Economic Development Partnership. This consortium meets monthly to discuss pressing economic issues impacting the state and to prioritize and manage its independent research efforts.

For this report Common Sense Policy Roundtable partnered with Colorado Succeeds, a leading voice in Colorado for improving the state's education system, to answer a vital question: What if Colorado schools were number one? This report primarily answers this question by measuring the economic impact of Colorado high school graduates going on to obtain the level of post-secondary education need to meet the workforce demands of the Colorado economy.

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Introduction

In August 2017 more than 64,800 students across Colorado started their fourth year of high school. By May 2018, only 51,000 students, or just 79% of the class, are projected to graduate. At the end of the next school year, another 3,400 members of that same class will complete their high school education within five years of leaving 8th grade, bringing the 5-year graduation rate to 84.1%.

This means more than 10,600 students from the class of 2017-2018 remain without a high school degree within five years of entering high school. Next year's class will produce another 10,600 -- or more -- students without a high school degree and every class for the foreseeable future will likely be similar.
While Colorado's K-12 graduation rate is improving, increasing from 75.4% in 2012, it still ranks 45th nationally (National Center for Education Statistics, 2017).

Although 84% of each class will graduate within five years, only 64% will go on to obtain some form of post-secondary education. This includes bachelor's degrees, master's degrees, and associate degrees, as well as industry certificates and other forms of post-secondary education credentials. Meanwhile, 74% of jobs in Colorado will require some form of post-secondary education by 2020. (Data is from the report *Recovery; Projections of Jobs and Education Requirements through 2020*, released by the Georgetown University Center on Education and the Workforce (Carnevale, Smith, & Strohl, 2013))

This begs a simple question; ***What if Colorado schools were number one?*** More specifically, what would be the value to the Colorado economy of improving the level of education of more students going through our K-12 system?

While there are numerous ways to measure the value to society of improving education outcomes, this paper researches what value would be added to the state's economy. Understanding not only why education matters to each of us individually but understanding why education matters to our state's economic health provides context to those who are weighing multiple policy priorities with limited budgets. This paper presents a series of results and a description of our methodology across different economic impact scenarios. For example:

If next year's 12th grade class achieved a level of education proportional to workforce needs, an additional 6,200 students would obtain some form of post-secondary education against the current baseline. If the 5-year graduation rate were increased by an additional 9 percentage points to match Iowa's as the highest in the country, next year's class would see an additional 4,267 students ultimately obtain some form of post-secondary education against the baseline, assuming today's rates of post-secondary educational attainment.

However, the results show that just graduating more students from K-12 each year is insufficient progress. The current and future workforce demands higher levels of education than our current K-12 graduates are achieving on average. And too many students graduate from high school unprepared to do college-level work. Currently, more than a third of Colorado high school graduates need to take remedial courses, before they're deemed qualified for college-level coursework (Colorado Department of Higher Education, 2016).

Knowing that 74% of projected 2020 Colorado jobs will require some form of post-secondary education, these challenges will only grow more daunting over time. As automation and artificial intelligence drive major changes in our economy and society, an increasing proportion of high school graduates will need to continue their education beyond high school.

While Colorado is fortunate to be able to attract a world-class talent pool from the across the country and world, improving the likeliness of Colorado's students to compete and thrive in today's labor market is important to the future economic health of the state.

The economic impacts of our two scenarios show that just 10 graduating classes with increased levels of educational attainment would add between $850 million and $1.4 billion in Gross State Product every year. Over the span of 10 years, the increase in GDP would be over $12 billion.

Economic Impact Scenarios

Whether by measuring the post-secondary educational attainment outcomes of today's 12th grade classrooms against what is demanded by today's workforce, or by measuring the difference between the current K-12 graduation rates and the best in the country, it is clear a sizeable gap exists. The goal of this research is not just to identify that a gap exists but to provide some insights into what the impacts would be if that gap were eliminated. To do this, we developed two separate economic impact scenarios that measure the change in the actual number of students, the increase in direct earnings and the macroeconomic impacts to the state.

Scenario 1 - What if each graduating class of high school seniors went on to obtain the forms of higher education that are currently demanded by the Colorado job market?

Scenario 2 - What if Colorado could achieve the highest graduation rate in the country, and the additional graduates continued to obtain forms of higher education at current rates?

The results for each scenario are presented across three areas of impacts.

1. Direct change in education attainment by the number and percent of students from each class
2. Direct change in earnings by each class
3. Statewide economic impacts for single class and consecutive graduating classes over time

For the second scenario, along with determining the impact if the overall graduation rate improved, we also created two additional simulations to be able to isolate the impacts if two groups within the overall student population were able to achieve the best graduation rate in the country. Those groups include;

1. Economically disadvantaged students - These are students who qualify for free and reduced lunches.
2. Racial equity gap - This includes students of racial groups who on average achieve lower graduation rates than the overall class average. (further detail in Methodology)

The following sets of tables and figures provide estimates of the impact to the Colorado economy of improving the education attainment of each 12th grade graduating class over the next 20 years. There are various ways to capture the economic impacts of improving K-12 schools, including measuring the correlation of student achievement through the National Assessment of Educational Progress(NAEP) and a state's economic growth (Hanushek, Ruhose, & Woessman, 2016), but the scenarios in this report focus on understanding the macroeconomic impacts related to increased productivity and higher average wages across each level of education.

Timing and Scope of the Impacts

A forecast of the next 20 years of 12th grade classes was used to establish the number of students associated with the potential increase in education attainment and increase in economic value. However, the timing of the potential economic impacts would not occur immediately following the graduation of each additional class. While we describe the class size and additional graduates by a specific year, we present the direct earnings and macroeconomic impacts over a 20-year window not specifically tied to a given set of years. Upon graduating high school, students still need to spend several more years obtaining higher forms of education, and then be in the workforce for several more years before beginning to earn the average increase in earnings associated with the different form of education. The increase in direct earnings and macroeconomic impacts represent the full potential impacts in a single year once, likely beginning within 10-20 years following the completion of high school.

Understanding that the full potential impacts may not occur for some time following the completion of K-12 and even post-secondary attainment, also accounts for the fact that there will be an increase in monthly expenses to pay for the additional education in the form of student loans. While the burden of student loans can be significant, the difference in average monthly earnings is greater than the average monthly cost of student loans and on average cumulative net earnings of higher forms of education surpass the earnings with just a high school diploma between the ages of 30 and 36 (Ma, Pender, & Welch, 2016).

While this study aims to quantify the macroeconomic impacts of the earnings and productivity from a more educated workforce, there are many other forms of economic impacts that could be attributed to improving K-12 schools. While we only capture the average earnings increase, it is likely that some new graduates would start businesses and invent new products which could have significantly greater impacts than the averages suggest. There are other studies that suggest that improved schools immediately increase the value of surrounding properties as people are willing to pay more to live within better performing school district (Black, 1998).

According to the report, *Value of a High School Diploma*, released June 2017 by the Alliance for Choice in Education (Alliance for Choice in Education, 2017), the benefits of completing high school and then graduating from different forms of post-secondary education go well beyond the direct increase in earnings. The report's findings conclude that students without high school diplomas are less able to live independently, have less stable family lives, and are less engaged civically. Over the lifetime of a high school dropout the cost to the individual is over $1.1 million and the cost to society is $292,000 due to lower tax revenues, and higher costs related to social programs and incarceration. In 2016 there were 12,456 non-high school completers estimated to cost over $18.3 B more over their lifetimes.

Discussion on Categories of Education Attainment

This report uses a consistent categorization of education attainment, given the lowest common denominator across the various forms of data we needed to collect. There are more detailed categories of education than are displayed in this report however for our purposes we needed to use a consistent framework across all our data points. The level of detail in state earnings data by education attainment varies from the overall educational attainment of Colorado natives. Here are the categories of educational attainment that are used throughout the study.

- Less than high school
- High school only
- Some college/no degree
- Certificate
- Associate's degree
- Bachelor's degree
- Master's degree of higher

While most categories are self-explanatory the categories of some college/no degree and certificates warrant slightly more discussion. Some college/no degree is generally a catch-all for individuals with a high school degree but no formal degree from a 2-year associate's program or 4-year bachelor's program or some more advanced degree. It includes individuals who start some form of higher education but never finish as well as other forms of educational attainment such as apprenticeships and long-term on-the-job-training. Technically, the category of certificates is also reported as being included in the category of Some college/no degree in some data sets. Using data from the Talent Pipeline report (Colorado Workforce Development Council, 2017), the estimate of the percentage of current and needed levels of certificates was isolated in the estimates for overall educational attainment. Similarly, the current share of each class who obtain an associate's degree was also separated from the some college/no degree category using data from the Carnevale/Georgetown study. The estimated change in both the number of student who obtain a certificate or an associates degree was aggregated back into the category of some college/no degree when multiplying by average annual earnings.

The report by the Georgetown Center on Education and Workforce that concluded 74% of all jobs in Colorado would require some form of post-secondary education by 2020, used the sum of some college/no degree including certificates, associate's degree, bachelor's degree and master's degree or higher. According to Table 1, which is developed using Census data on Colorado specific levels of education attainment by the Colorado native adult population over the age of 25, 64% have some form of post-secondary education. While these estimates are developed in a similar manner to the figures published by the Colorado Department of Higher Education, as part of their 2017 Master Plan (Colorado Department of Higher Education, August 2017) there are some key differences to point out.

The Colorado Master Plan uses the overall state average including non-native born adults including those born in other parts of the United States and other countries. US residents born in other states, along with US residents born in other countries both have higher levels of post-secondary education than native born Coloradans. Non-US natives born outside the US overall have a lower level of post-secondary education overall however still have higher levels of master's degrees or higher. Also, the Master Plan excludes the category of some college/no degree from its estimate of the current level of post-secondary attainment. Therefore, the Master Plan cites the figure that 55% of the adult population in Colorado have a degree or certificate. Using the same methodology for just the Colorado native born education attainment of the adult population, only 46% of have a degree beyond high school or a certificate.

Scenario 1 Results

The premise of scenario 1 is that the final educational attainment of each 12th grade class is proportional to demands of the Colorado workforce. Based upon the final educational attainment of Colorado residents born in Colorado, currently only an estimated 64% of each class go on to obtain some form of post-secondary education.

Table1: Educational attainment for each 12th grade class

Education level	**Current**	**Projected Workforce Need**
Less than high school	8%	7%
High school only	28%	20%
Some college/No degree	18%	16%
Certificate	7%	7%
Associate's Degree	9%	9%
Bachelor's Degree	21%	29%
Master's Degree or higher	9%	12%

The sum of the education level categories, some college/no degree through the bottom to Master's or higher, represent the total share of higher education beyond a high school degree. While the 5-year graduation rate is 84%, education attainment data for native Coloradans suggest only 8% of the population have less than a high school degree. For Scenario 1 we chose to use the education attainment rates rather than the graduation rates to be more conservative in our assumptions for the increase in earnings and associated economic impacts. There is no change in the categories of Certificate, and Associate's degree given the Census data does not report native educational attainment as such a detailed level. We assumed the current statewide average for both the baseline current class outcomes to be able to separate the category of some college/no degree and to be able to compare to the demands of the workforce.

Table 1 compares the current post-secondary attainment levels compared to what those levels need to be to meet the demands of Colorado employers. Based upon the percentages in Table 1, below is the estimated difference in educational attainment by the number of students for the 2018-2019 12th grade class.

Figure 1: Estimated change in number of students by educational attainment for class of 2019

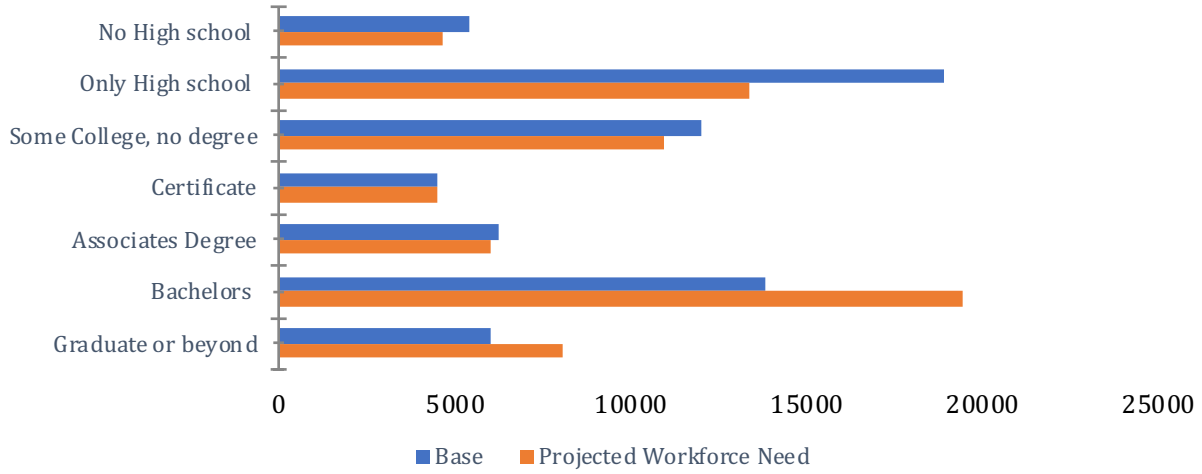
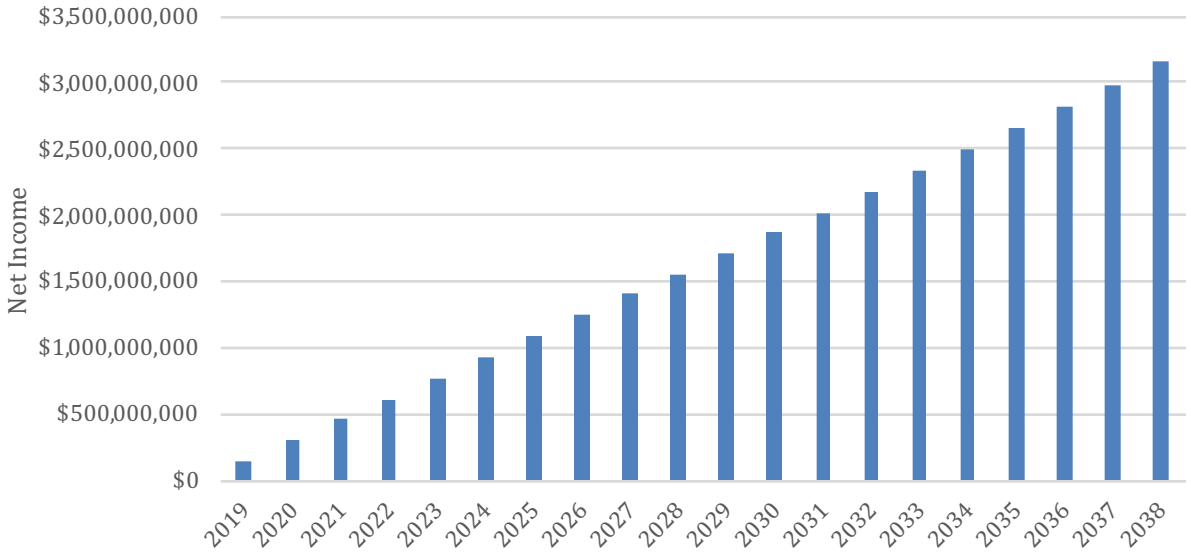


Figure 1 shows the difference in education levels for the current base projection of next year's class of Colorado high school seniors compared to the outcome if the post-secondary education level of next year's graduating class equaled the estimated demands for post-secondary education by the 2020 job market. By increasing the level of post-secondary educational attainment for the class of 2019, an additional nearly 6,200 students would obtain some form of post-secondary education compared to the current baseline.

The shift in the educational attainment of each class then leads to changes in average earnings by level of education. Using the average wage by level of educational attainment from Figure 8 in the appendix and multiplying each average by the total number of students by education level for each class in both the baseline and in the alternative, we estimate the difference in total earnings.

Overall, because the level of education increases, the net impact on total earnings by graduating class increases. Figure 2 shows the cumulative increase in earnings as each graduating class adds to the net positive impact in earnings. For the simulations, only 90% of 12th grade graduates from Colorado would remain in the Colorado workforce in any given year. The other 10% were assumed to move out of state and therefore we excluded from the simulation. While the percentage of individuals born in Colorado that still live in Colorado is below 90%, much of the out-migration occurs in early years, prior to graduating high school. And while a greater share of Coloradans chooses universities outside of Colorado a large portion of those student eventually return to Colorado to live and work after completing their education. Other studies have estimated the impacts based on 100% of graduates but we chose to be more conservative.

Figure 2: Cumulative annual increase in earnings under Scenario 1 (2016$)



The change in educational attainment for each graduating class causes some categories of education attainment to see less total earnings while others see more. The net impact is positive with over $150M generated per year by the first graduating class, and over $1.55B in earnings generated each year with just 10 additional graduating classes.

The additional earnings each year further increases local consumption demand, as that money is spent within the local economy. Using the dynamic economic simulation model called PI+, developed by REMI, we can capture the full regional economic impact as the additional consumption increases local sales in business across retail, healthcare, recreation, professional services and other sectors, and creates jobs and increases the overall size of the economy. Within PI+, entered the difference in direct earnings as an increase in the wage bill policy variable. The model then takes a portion out of the income for taxes and then increases the amount of local consumer spending according to historically estimated averages. As the dollars are spent on various consumer goods and services, a significant portion of the dollars "leak" out of the state as goods and services are imported and not directly produced in-state. Therefore, results concepts such as Gross State Product are slightly lower than even the direct earnings, as the increase in consumer spending goes to increasing value added in a different part of the country or the world.

Table 2: Scenario 1 Summary Annual Impacts – Increase in CO K-12 graduates with post-secondary education, increase in direct earnings and summary economic impacts

Scenario 1 Summary Annual Impacts	Year 1	Year 10	Year 20
Additional Students with Some Post-Secondary Education that Stay in CO	5,573	57,683	116,746
Increase in Direct Earnings ($2016 Millions)	$150,280,600	$1,555,587,900	$3,148,394,800
Total Jobs Impact (Units)	1,480	14,560	20,860
Total GDP Impact ($2018 Millions)	$195	$2,206	$4,014
Consumer Spending ($2018 Millions)	$206	$2,277	$4,391
Total Dynamic Fiscal Impact to State (excluding cost savings) ($Millions)	$8.617	$128.084	$302.372
Savings on Public Assistance, Supplemental Security Income and SNAP ($Millions)	$3.85	$39.87	$80.69
Savings on Lower Incarcerations ($Millions)	$0.48	$26.98	$103.66

The summary annual impacts show the benefits in a single year of having more educated and more productive Colorado 12th grade graduates. The impacts in Year 1 represent the economic impacts generated because of just a single additional 12th grade class with higher levels of post-secondary education attainment. Year 10 and Year 20 show the impact in a single year with just 10 or 20 additional graduating classes living and working in Colorado. While a single graduating class would contribute an additional $195 million to state GDP, after 10 years with 10 additional graduating classes, they would contribute an additional $2.2 billion to the state's GDP.

Table 3: Cumulative Macroeconomic Impacts Scenario 1

Scenario 1 Summary Annual Impacts	10 Year Sum	20 Year Sum
Increase in Direct Earnings ($2016 Millions)	$8,516,867,000	$32,719,225,600
Total GDP Impact ($2018 Millions)	$12,465	$44,397
Consumer Spending ($2018 Millions)	$12,500	$46,945
Total Dynamic Fiscal Impact to State (excluding cost savings) ($ Millions)	$660.167	$2,840.053
Savings on Public assistance, Supplemental Security Income and SNAP ($ Millions)	$218.28	$838.57
Savings on Lower Incarcerations ($Millions)	$107.43	$757.27

The 10-year sum and 20-year sum, represent the cumulative impact over a span of multiple years. Therefore, the 10-year sum equals Year 1, plus Year 2, plus Year 3 and so on through Year 10. The results related to an annual stock of people or jobs do not have a cumulative sum given the same people and job exist from year-to-year whereas a value such as GDP starts at $0 and accrues throughout the year.

Table 4: Scenario 1 - Impact on consumer spending of single improved graduating class ($2018M)

Consumer Spending Category ($2018 M)	Year 1	10 Year Sum
Motor vehicles and parts	$8.62	$472.24
Furnishings and durable household equipment	$9.08	$583.05
Recreational goods and vehicles and other durable goods	$15.24	$993.27
Food and beverages purchased for off-premises consumption	$9.40	$612.27
Clothing and footwear	$6.00	$375.21
Motor vehicle fuels, lubricants, and fluids	$2.31	$149.18
Fuel oil and other fuels	$0.06	$3.01
Other nondurable goods	$18.95	$1,155.37
Housing	$22.15	$1,413.12
Household utilities	$2.74	$168.36
Transportation services	$10.51	$543.96
Health care	$28.41	$1,843.53
Recreation and other services	$72.77	$4,187.39

The increase in earnings generated by each graduating class will largely go to increasing consumer demand on different products and services. Table 4 shows the amount that several categories of consumer spending would increase. While spending on housing will increase by over $22 million a portion of that will go the purchasing on new homes. As such the total value of the purchase will be much higher than just the increase in annual spending on a mortgage.

Scenario 2 Results

The results of Scenario 2 estimate the economic value created by increasing the annual graduation rate in Colorado to the best in the country. Importantly, this scenario assumes additional graduates with each class then go on to earn higher forms of post-secondary education proportional to the current levels of post-secondary education in Colorado. The purpose of this scenario is not to suggest that just improving 12th grade graduation rates will lead to an increase in economic growth, but rather use the graduation rate as a means of testing the value of getting more students to graduate 12th grade and pursue post-secondary education at the current rates of attainment.

As noted in the introduction, given the high level of education demanded by the Colorado job market, this scenario still does not see enough Colorado educated 12th grade graduates go on to earn the types and number of post-secondary education needed. Further, this scenario demonstrates that improving the high school graduation rate to the highest in the country is not enough.

For Scenario 2 we also isolated to two groups within each graduating class. Along with the entire class, we measured the impacts from just improving the graduation rate of the students designated as economically disadvantaged and students that are within the racial equity gap. Economically disadvantaged students are those that qualify for free and reduced lunch and represent 45% of the entire graduation base. Student within the racial equity gap are those that identify in a racial category that has a graduation rate below the entire class average and represent 37% of the entire grad base. Each race that is part of this category is shown in the methodology section.

Figure 3: Annual increase in additional Colorado 12th grade graduates over time

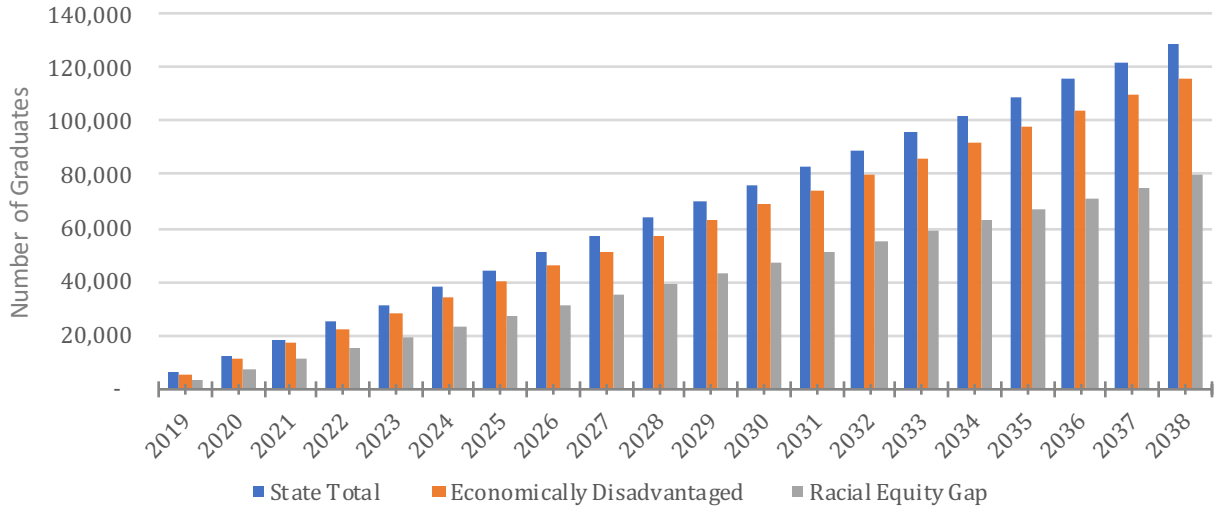


Figure 3 shows the annual growth in additional 12th grade graduates by category after multiple years of the number one graduation rate in the country. While there would just be an additional 6,155 with next year's class, after 10 years of improved graduation rates there would be 63,715 additional 12th grade graduates and 128,955 after 20 years.

With the addition of more high school graduates, some will go on to complete additional forms of post-secondary education. Of those that graduate high school, table 4 shows the current average distribution of final education attainment.

Table 5: Share of final levels of educational attainment for those that graduate high school

% of HS graduates who receive no further education	30.7%
% of HS graduates who achieve some college but don't obtain a degree	19.6%
% of HS graduates who receive a certificate	7.3%
% of HS graduates who receive an associate's degree	10.2%
% of HS graduates who receive a bachelor's degree	22.5%
% of HS graduates who receive a graduate or professional degree	9.8%

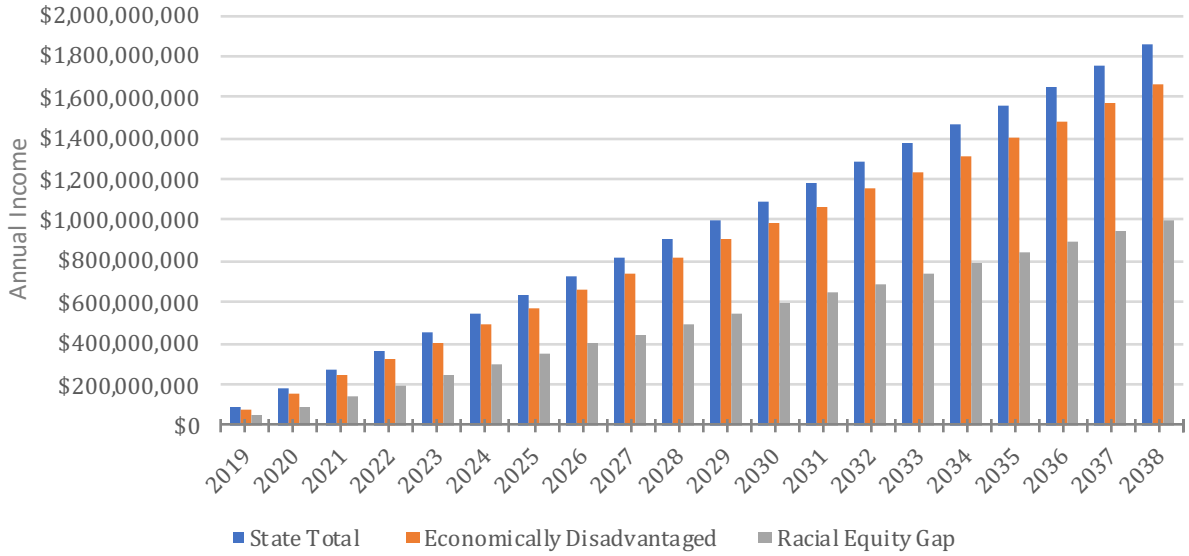
The additional graduates from figure 3, are then assumed to obtain forms of higher education. The difference in annual earnings relative to less than a high school degree are shown in Table 6, and resulting net increase in total earnings for each additional graduating class is shown in Figure 4.

Table 6: Difference in earnings by level of education attainment relative to no high school

Education Level	**$ difference**	**% of Less than high school only**
Less than high school graduate	$0	100%
High school graduate (includes equivalency)	$6,948	130%
Some college/No degree or Associate's degree	$11,294	148%
Bachelor's degree	$25,365	207%
Graduate or professional degree	$39,984	268%

Source: Median Earnings in the Past 12 months (2016 inflation adjusted dollars) for population over age of 25 by education attainment in Colorado, U.S. Census

Figure 4: Cumulative additional annual earnings with each new class



The total additional earnings were then entered the model through the same policy variables described in scenario 1. The following tables show the economic impact results for all three simulations.

Table 7: Scenario 2 Entire Class Summary Annual Impacts – Increase in CO K-12 graduates with post-secondary education, increase in direct earnings and summary economic impacts

Scenario 2 Summary Annual Impacts	Year 1	Year 10	Year 20
Additional Students with Some Post-Secondary Education that Stay in CO	5,540	57,344	116,060
Increase in Direct Earnings ($2016 Millions)	$88,339,000	$914,416,300	$1,850,710,900
Total Jobs Impact (Units)	870	8,560	12,260
Total GDP Impact ($2018 Millions)	$115	$1,296	$2,358
Consumer Spending ($2018 Millions)	$121	$1,338	$2,579
Total Dynamic Fiscal Impact to State (excluding cost savings) ($Millions)	$5.065	$75.287	$177.727
Savings on Public Assistance, Supplemental Security Income and SNAP ($Millions)	$3.65	$37.82	$76.55
Savings on Lower Incarcerations ($Millions)	$4.62	$47.78	$96.70

The summary annual impacts show the benefits in a single year of having more educated and more productive Colorado 12th grade graduates. The impacts in Year 1 represent the economic impacts generated because of just a single additional 12th grade class with higher levels of post-secondary education attainment. Year 10 and Year 20 show the impact in a single year with just 10 or 20 additional graduating classes living and working in Colorado. While a single graduating class would contribute an additional $115 million to state GDP, after 10 years with 10 additional graduating classes, they would contribute an additional $1.30 billion to the state's GDP.

Table 8: Scenario 2 Summary Cumulative Impacts – Entire Class

Scenario 2 Summary Annual Impacts	10 Year Sum	20 Year Sum
Increase in Direct Earnings ($2016 Millions)	$5,006,442,800	$19,233,238,200
Total GDP Impact ($2018 Millions)	$7,325	$26,085
Consumer Spending ($2018 Millions)	$7,346	$27,582
Total Dynamic Fiscal Impact to State (excluding cost savings) ($ Millions)	$388.047	$1,669.309
Savings on Public assistance, Supplemental Security Income and SNAP ($ Millions)	$207.07	$795.52
Savings on Lower Incarcerations ($Millions)	$261.59	$1,004.97

The 10-year sum and 20-year sum, represent the cumulative impact over a span of multiple years. Therefore, the 10-year sum equals Year 1, plus Year 2, plus Year 3 and so on through Year 10. The results related to an annual stock of people or jobs do not have a cumulative sum given the same people and job exist from year-to-year whereas a value such as GDP starts at $0 and accrues throughout the year.

Table 9: Distribution of Consumer Spending Scenario 2 - Entire grad class($2018M)

Consumer Spending Category ($2018 M)	***Year 1***	***10 Year Sum***
Motor vehicles and parts	$5.07	$277.47
Furnishings and durable household equipment	$5.34	$342.55
Recreational goods and vehicles and other durable goods	$8.95	$583.56
Food and beverages purchased for off-premises consumption	$5.52	$359.90
Clothing and footwear	$3.53	$220.48
Motor vehicle fuels, lubricants, and fluids	$1.36	$87.69
Fuel oil and other fuels	$0.03	$1.77
Other nondurable goods	$11.14	$679.08
Housing	$13.02	$830.72
Household utilities	$1.61	$98.97
Transportation services	$6.18	$319.59
Health care	$16.70	$1,083.39
Recreation and other services	$42.77	$2,460.51

The increase in earnings generated by each graduating class will largely go to increasing consumer demand on different products and services. Table 8 shows the amount that several categories of consumer spending would increase. While spending on motor vehicles and parts will increase by over $5 million a portion of that will go the purchasing on new and used vehicles. As such the total value of the purchase will be much higher than just the increase in annual spending car payments.

Table 10: Scenario 2 Economically Disadvantaged Students Summary Annual Impacts – Increase in CO K-12 graduates with post-secondary education, increase in direct earnings and summary economic impacts

Scenario 2 Summary Annual Impacts – Economically Disadvantaged	**Year 1**	**Year 10**	**Year 20**
Additional Students with Some Post-Secondary Education that Stay in CO	4,974	51,485	104,201
Increase in Direct Earnings ($2016 Millions)	$79,312,800	$821,064,800	$1,661,774,400
Total Jobs Impact (Units)	780	7,690	11,010
Total GDP Impact ($2018 Millions)	$103	$1,164	$2,117
Consumer Spending ($2018 Millions)	$109	$1,201	$2,316
Total Dynamic Fiscal Impact to State (excluding cost savings) ($Millions)	$4.547	$67.600	$159.581
Savings on Public Assistance, Supplemental Security Income and SNAP ($Millions)	$3.28	$33.96	$68.73
Savings on Lower Incarcerations ($Millions)	$4.14	$42.90	$86.82

The summary annual impacts show the benefits in a single year of having more educated and more productive Colorado 12th grade graduates. The impacts in Year 1 represent the economic impacts generated because of just a single additional 12th grade class with higher levels of post-secondary education attainment. Year 10 and Year 20 show the impact in a single year with just 10 or 20 additional graduating classes living and working in Colorado. While a single graduating class would contribute an additional $103 million to state GDP, after 10 years with 10 additional graduating classes, they would contribute an additional $1.164 billion to the state's GDP.

Table 11: Scenario 2 Economically Disadvantaged Students Cumulative Macroeconomic Impacts

Scenario 2 Summary Cumulative Impacts - Economically Disadvantaged	10 Year Sum	20 Year Sum
Increase in Direct Earnings ($2016 Millions)	$5,006,442,800	$19,233,238,200
Total GDP Impact ($2018 Millions)	$7,325	$26,085
Consumer Spending ($2018 Millions)	$7,346	$27,582
Total Dynamic Fiscal Impact to State (excluding cost savings) ($ Millions)	$388.047	$1,669.309
Savings on Public assistance, Supplemental Security Income and SNAP ($ Millions)	$207.07	$795.52
Savings on Lower Incarcerations ($Millions)	$261.59	$1,004.97

The 10-year sum and 20-year sum, represent the cumulative impact over a span of multiple years. Therefore, the 10-year sum equals Year 1, plus Year 2, plus Year 3 and so on through Year 10. The results related to an annual stock of people or jobs do not have a cumulative sum given the same people and job exist from year-to-year whereas a value such as GDP starts at $0 and accrues throughout the year.

Table 12: Distribution of Consumer Spending Scenario 2 - Economically disadvantaged

Consumer Spending Category ($2018 M)	***Year 1***	***10 Year Sum***
Motor vehicles and parts	$4.55	$249.12
Furnishings and durable household equipment	$4.79	$307.56
Recreational goods and vehicles and other durable goods	$8.04	$523.94
Food and beverages purchased for off-premises consumption	$4.96	$323.15
Clothing and footwear	$3.17	$197.96
Motor vehicle fuels, lubricants, and fluids	$1.22	$78.73
Fuel oil and other fuels	$0.03	$1.59
Other nondurable goods	$10.00	$609.74
Housing	$11.69	$745.91
Household utilities	$1.45	$88.87
Transportation services	$5.55	$286.94
Health care	$14.99	$972.75
Recreation and other services	$38.40	$2,209.19

The increase in earnings generated by each graduating class will largely go to increasing consumer demand on different products and services.

Table 13: Scenario 2 Racial Equity Gap Students Summary Annual Impacts – Increase in CO K-12 graduates with post-secondary education, increase in direct earnings and summary economic impacts

Scenario 2 Summary Annual Impacts – Racial Equity Gap	Year 1	Year 10	Year 20
Additional Students with Some Post-Secondary Education that Stay in CO	3,422	35,420	71,688
Increase in Direct Earnings ($2016 Millions)	$47,822,400	$495,020,500	$1,001,884,800
Total Jobs Impact (Units)	470	4,630	6,640
Total GDP Impact ($2018 Millions)	$62	$701	$1,276
Consumer Spending ($2018 Millions)	$66	$724	$1,396
Total Dynamic Fiscal Impact to State (excluding cost savings) ($Millions)	$2.742	$40.753	$96.207
Savings on Public Assistance, Supplemental Security Income and SNAP ($Millions)	$2.26	$23.36	$47.28
Savings on Lower Incarcerations ($Millions)	$2.85	$29.51	$59.73

Table 14: Scenario 2 Racial Equity Gap Students Cumulative Macroeconomic Impacts

Scenario 2 Summary Cumulative Impacts – Racial Equity Gap	10 Year Sum	20 Year Sum
Increase in Direct Earnings ($2016 Millions)	$2,710,244,600	$10,411,939,400
Total GDP Impact ($2018 Millions)	$3,965	$14,117
Consumer Spending ($2018 Millions)	$3,976	$14,927
Total Dynamic Fiscal Impact to State (excluding cost savings) ($ Millions)	$210.057	$903.620
Savings on Public assistance, Supplemental Security Income and SNAP ($ Millions)	$127.91	$491.38
Savings on Lower Incarcerations ($Millions)	$161.58	$620.75

Table 15: Distribution of Consumer Spending Scenario 2 - Racial Equity Gap

Consumer Spending Category ($2018 M)	***Year 1***	***10 Year Sum***
Motor vehicles and parts	$2.74	$150.16
Furnishings and durable household equipment	$2.89	$185.37
Recreational goods and vehicles and other durable goods	$4.85	$315.80
Food and beverages purchased for off-premises consumption	$2.99	$194.82
Clothing and footwear	$1.91	$119.32
Motor vehicle fuels, lubricants, and fluids	$0.73	$47.47
Fuel oil and other fuels	$0.02	$0.96
Other nondurable goods	$6.03	$367.58
Housing	$7.05	$449.70
Household utilities	$0.87	$53.58
Transportation services	$3.34	$172.95
Health care	$9.04	$586.38
Recreation and other services	$23.15	$1,331.64

The increase in earnings generated by each graduating class will largely go to increasing consumer demand on different products and services.

Methodology

To determine the economic impact to the state of Colorado from improving the educational attainment of its K-12 graduates, detailed simulations were developed to reflect the change in annual earning and productivity for each graduating class against the status-quo. The simulations were run through the dynamic forecasting and simulation model, Tax-PI. Tax-PI is a dynamic economic model custom built by the company REMI, to reflect the Colorado economy and be able to answer what-if questions regarding the impacts of alternative policy or economic scenarios.

Scenario 1 - What if each graduating class of high school seniors went on to obtain the forms of higher education that are currently demanded by the Colorado job market?

Scenario 2 - What if Colorado could achieve the highest graduation rate in the country, and have the additional graduates obtain forms of higher education at current rates?

Within the context of Scenario 2, this study modeled three separate simulations to isolate two specific subgroups of K-12 students to better understand their impacts in relation the to the state averages. Along with general insight, this may prove most helpful in determining specific policy choices to obtain these improved outcomes.

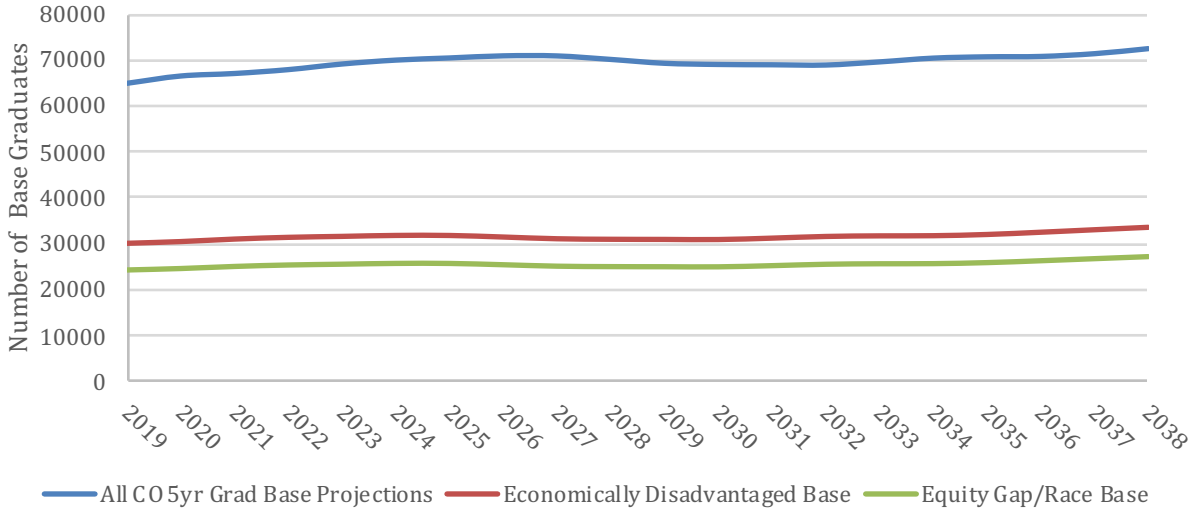
Within Scenario 2, the three simulations estimate the impacts of improving the K-12 graduation rate across three groups of students;

1. Total number of students from each K-12 graduation class
2. Economically disadvantaged students only
3. Students from racial equity gap only– Students from racial categories with graduation rates below state average
    a. American Indian and Alaska Native
    b. Black or African American
    c. Hispanic or Latino
    d. Native Hawaiian or other Pacific Islander
    e. Two or more races

Developing the baseline

The initial step was to estimate what the current educational attainment and income would be for each graduating class over the next 20 years as a baseline. The projected size of each 12th grade class from 2019 to 2038 is developed using a five-year average from 2012 to 2016 of the size of the 12th grade class from historical data released by the Colorado Department of Education relative to the size of the population cohort of 17 to 18-year-olds from the historical data from the Colorado Office of Demography. This approach showed that the 12th grade class size was equal to 44.12% of the 17 to 18-year-old cohort. This ratio was then applied to the annual projections of that cohort from the Colorado Office of Demography. The Western Interstate Commission for Higher Education(WICHE) has released separate estimates for the projections of Colorado's 12th grade class size however they only provide estimates through 2031 and we desired a 20-year window through 2038. Our estimates are comparable as our 2031 estimate is a class size of 69,366 students and WICHE's estimate is 70,002.

Figure 5: Baseline projection of annual class size

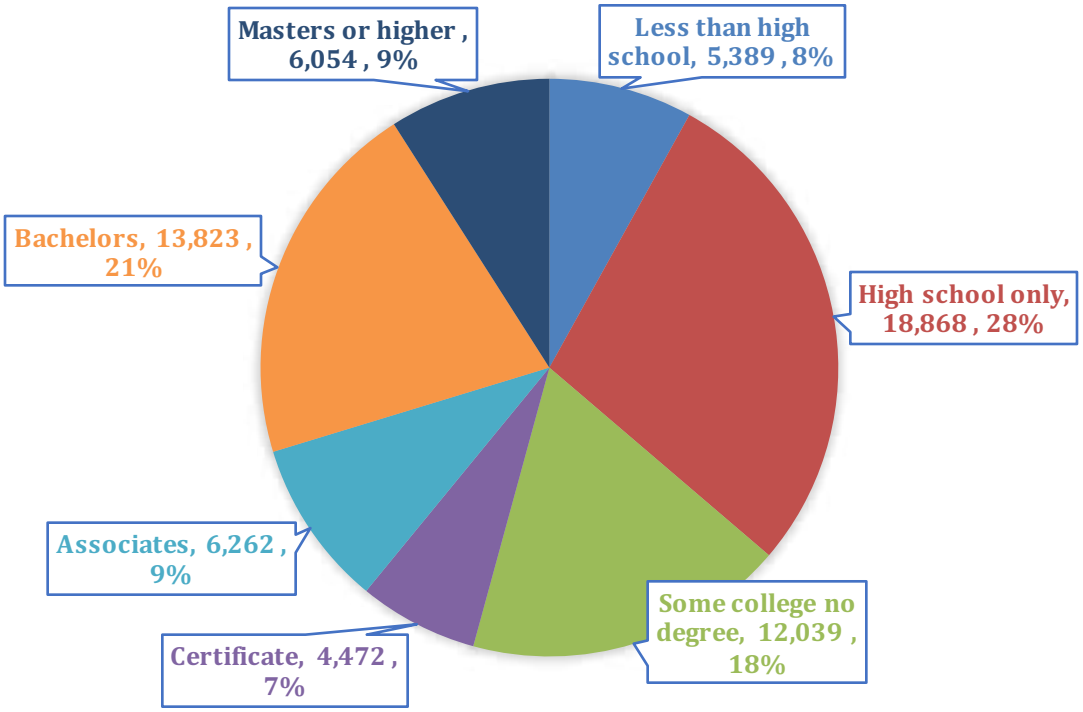


After developing the baseline for the number of students, we then estimated the level of final education based upon the current estimates of educational attainment of Colorado natives from the Census. While this is not an exact estimate for each graduating class, currently Colorado does not have any means to track the actual performance of 12th grade graduates as they move on to obtain further levels of education and choose to remain in Colorado or not. Therefore, we also assumed only 90% of each graduating class ultimately was present in the Colorado workforce each year.

While the current 4-year graduation rate in Colorado is 79% and the 5-year graduation rate is 84.1%, the estimates from the census suggest that only 8% of all native adults have less than a high school education. This would mean that roughly 8% of each 12th grade class obtains some form of high school equivalency credential or some other form of education such as a certificate or formal apprenticeship.

Here is the current assumed distribution for the education attainment for each 12th grade class;

Figure 6: Current education attainment distribution assumed for each high-school class



The categories of certificates and associates degrees were separated from the category of some college/no degree described in the section 'Discussion on Categories of Education Attainment'.

Upon determining the number of students by level of educational attainment, we then estimated the total annual earnings for each class based upon the average annual earnings by level of education.

Figure 7: Annual average earnings by level of education

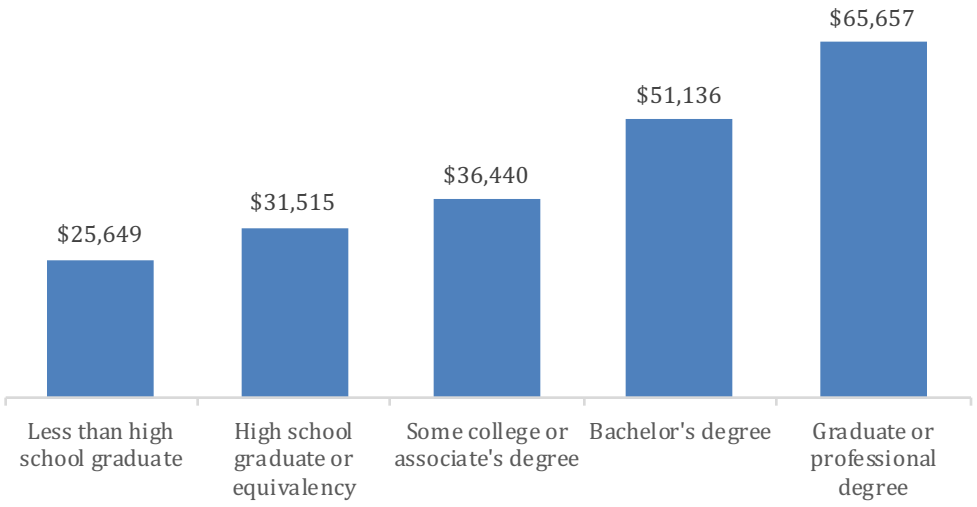


Table 16: Baseline Summary Annual Impacts

Baseline	Year 1	Year 10	Year 20
Base Income ($)	$2,321,730,163	$24,032,745,705	$48,640,498,770
Total Jobs Impact (Units)	$24,873	$218,060	$312,084
Total GDP Impact ($2018 Million)	$2,131	$21,575	$36,013
Consumer Spending ($2018 Million)	$2,717	$28,840	$55,201

Table 17: Baseline Summary Cumulative Impacts

Baseline	10 Year Sum	20 Year Sum
Base Income ($)	$131,579,640,978	$505,489,159,500
Total Jobs Impact (Units)	$1,346,212	$4,073,449
Total GDP Impact ($2018 Million)	$127,211	$422,209
Consumer Spending ($2018 Million)	$159,859	$593,633

Developing the alternative scenario projections

Scenario 1 – What if each graduating class of high school seniors went on to obtain the forms of higher education that are currently demanded by the Colorado job market?

Starting with the same grad base as described for the baseline scenario, Scenario 1 increases the educational attainment for each class to match the needs of the current labor market.

Table 18: Education attainment of current class compared to needs of workforce

Education Level	**Baseline**	**Scenario 1**	**% Change**
No High school	4,850	4,215	-13.1%
Only High school	16,981	12,043	-29.1%
Some College/No degree	10,835	9,824	-9.3%
Certificate	4,025	4,025	0.0%
Associates Degree	5,635	5,419	-3.8%
Bachelors	12,441	17,462	40.4%
Graduate or beyond	5,448	7,226	32.6%

The total number of students by level of education attainment, was then multiplied by the average wage for each level of education. The difference between the baseline, and Scenario 1 represents the overall increase in earnings because of higher overall levels of education.

Table 19: Annual Earnings by level of education attainment

Education Level	2016 estimate - Median earnings in past 12 months
Less than high school graduate	$25,649
High school graduate (includes equivalency)	$31,515
Some college/No degree or associate's degree	$36,440
Bachelor's degree	$51,136
Graduate or professional degree	$65,657

Table 20: Change in direct earnings by level of education

Education Level	Baseline	Workforce Need	% Change
No High school	$ 115,891,564	$ 100,720,391	-13.1%
Only High school	$ 523,745,924	$ 371,450,917	-29.1%
Some College/No degree	$ 381,263,414	$ 345,710,144	-9.3%
Certificate	$ 141,638,162	$ 141,638,162	0.0%
Associates Degree	$ 198,301,711	$ 190,701,511	-3.8%
Bachelors	$ 612,843,788	$ 860,205,856	40.4%
Graduate or beyond	$ 348,045,601	$ 461,583,780	32.6%

The increase in earnings is assumed to be driven by an increase in labor productivity as opposed to simply an increase in costs to employers. While there is a strong economic linkage between increases in education and increases in labor productivity, the exact value associated with each incremental improvement in education is not conclusive in the literature. As such, upon review of similar economic impact studies related to education attainment, and other material, we chose a conservative assumption of an increase in labor productivity equal to 1.5 times the increase in earnings. In the model baseline, the current ration of labor productivity to earning is just over 2.5. Put another way, the average annual labor productivity is two-and-a-half times higher than the average annual earnings. We chose not to assume the full difference of 2.5 given that additional education would only add some marginal increase in labor productivity rather than the full baseline average. The total dollar value representing the increase in labor productivity was then divided by the total value of labor productivity in the REMI baseline to obtain the value as a percentage change as is needed for the model input.

Table 21: Increase in labor productivity as a percent relative to the baseline

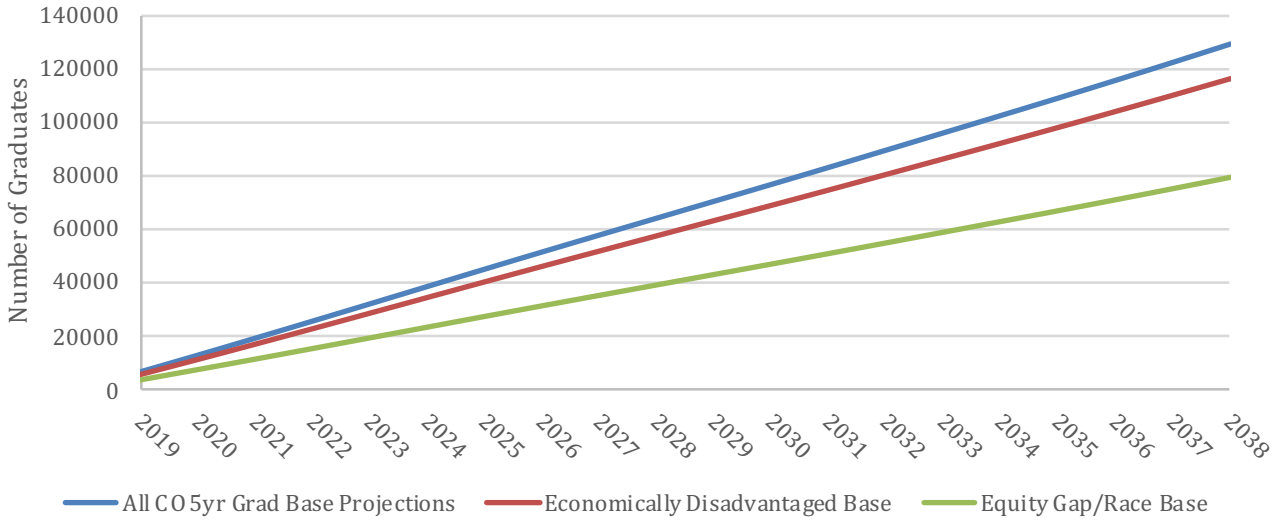
		Year 1	Year 5	Year 10	Year 15	Year 20
Scenario #1	All CO Graduates	0.038%	0.181%	0.330%	0.442%	0.528%

The net increase in earnings, along with the increase in labor productivity were both then entered the Tax-PI model as policy variables. For the earnings, the wage bill policy variable was selected while the labor productivity policy variable as a percent was selected to input the labor productivity increase.

Scenario 2 - What if Colorado could achieve the highest graduation rate in the country, and have the additional graduates obtain forms of higher education at current rates?

Scenario 2 uses the same starting class size as developed for the baseline scenario. The estimates for the grad base of students for the economically disadvantaged segment and the racial equity gap were developed using a 5-year average of each group relative to the entire class size from 2012 to 2016. The 5-year average for the economically disadvantaged group relative to the entire class is 45.14% and 36.56% for the racial equity gap. These percentages were then multiplied by the annual grad base size from the baseline projection.

Figure 8: Baseline projection of cumulative number of Graduates over time



Each grad base was then multiplied by the current 5-year graduation rate for each group. A 5-year graduation rate represents the relative number of students who graduate high school within 5-years of transitional from 8th grade. The current 4-year graduation rate, or the relative number of students who complete high school in 4 years of transitioning from 8th grade is 79%, over 4% lower than the 5-year rate. We chose to use the 5-year rate as we wanted to be conservative in our estimates of the economic impacts, as the 4-year rate would have assumed that over 2,600 students never completed high school who simply took another year to graduate. An argument could be made to use the 4-year rate as other similar studies have done, given the difference represents a population that is less likely to move onto higher forms of education but is talented enough to complete high school.

Overall graduation rate = 84.1%
Economically disadvantaged graduation rate = 75%
Racial equity gap graduation rate = 77.8%

Iowa currently has the highest 5-year graduation rate in the country at 93.3%. While Iowa also reports a graduation rate for each group of students in Scenario 2, we chose to use the 93.3% to represent the aspirational target for each group. We saw no reason to assume a lower graduation rate for each group students. It should be noted that the graduation rate for each group in Iowa is above the rate in Colorado, which suggests that the difference in the overall rate is not simply an artifact of less diversity.

The estimate for the additional number of students that would graduate each year and be able to go on to earn higher forms of education was derived by taking the difference in applying the current graduation rate and the highest graduation rate in the country to the baseline grad base.

Table 22: Cumulative annual increase in graduates assuming best graduation rate in the country.

	2019	2023	2028	2033	2038
State Total	6,155	31,602	63,715	95,680	128,955
Economically Disadvantaged	5,526	28,373	57,205	85,903	115,779
Racial Equity Gap	3,802	19,520	39,356	59,100	79,653

The additional number of graduates each year was then multiplied by the shares of educational attainment based upon the current distribution of Colorado natives.

Table 23: Percent distribution of educational attainment for students who graduate high school

	Current
Less than high school	8%
High school only	28%
Some college/No degree	18%
Certificates	7%
Associates	9%
Bachelors	21%
Masters or higher	9%

The sum of the education level categories, some college/no degree through the bottom to Master's or higher, represent the total share of higher education beyond a high school degree. While the 5-year graduation rate is 84%, education attainment data for native Coloradans suggest only 8% of the population have less than a high school degree. For Scenario 1 we chose to use the education attainment rates rather than the graduation rates to be more conservative in our assumptions for the increase in earnings and associated economic impacts. There is no change in the categories of Certificate, and Associate's degree given the Census data does not report native educational attainment as such a detailed level. We assumed the current statewide average for both the baseline current class outcomes to be able to separate the category of some college/no degree and to be able to compare to the demands of the workforce.

The total number of students by final level of education attainment, was then multiplied by the difference in annual average earnings relative to not completing high school.

Table 24: Additional average annual earnings relative to less than high school

Education Level	$ difference	% of High School
Less than high school graduate	$0	100%
High school graduate (includes equivalency)	$6,948	130%
Some college or associate's degree	$11,294	148%
Bachelor's degree	$25,365	207%
Graduate or professional degree	$39,984	268%

Table 25: Increase in labor productivity as a percent relative to Tax-PI baseline

Scenario #2	Year 1	Year 5	Year 10	Year 15	Year 20
All CO Graduates	0.022%	0.106%	0.194%	0.260%	0.310%
Economically Disadvantaged	0.020%	0.095%	0.174%	0.233%	0.278%
Racial Equity Gap	0.012%	0.057%	0.105%	0.140%	0.168%

The total percentage increase in macro impacts for scenario 1 and scenario 2 entire class illustrates in the following tables.

Table 26: Economic impacts of scenarios relative to baseline

Scenario 1	Year 1	Year 10	Year 20
Direct Earnings ($2016 Million)	6.47%	6.47%	6.47%
Job Impacts (Units)	5.95%	6.68%	6.68%
Total GDP Impact ($2018 Million)	9.15%	10.23%	11.15%
Consumer Spending ($2018 Million)	7.58%	7.90%	7.95%
Scenario 2 Entire Class	**Year 1**	**Year 10**	**Year 20**
Direct Earnings ($2016 Million)	3.80%	3.80%	3.80%
Job Impacts (Units)	3.50%	3.93%	3.93%
Total GDP Impact ($2018 Million)	5.40%	6.01%	6.55%
Consumer Spending ($2018 Million)	4.45%	4.64%	4.67%

Conclusion

With each graduating class, more and more Colorado students fall behind what is demanded by the Colorado labor market. The rapid growth in skills that require more and more formal education and training present a challenge for Colorado educated students to be able to compete given the gap in post-secondary attainment and high school graduation rates. The challenge to close the gap is not insignificant, but the benefits of doing so are clear. The economic value in the form of higher earnings from a more highly educated Colorado native population benefits not only the students themselves, but all Coloradan's as growth in consumer demand and labor productivity give employers the confidence they need to invest and grow their business in Colorado.

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