

# Measuring the Economic Impact of the Pūhoro STEM Academy

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## Executive Summary

The Pūhoro Academy partners with a selection of secondary schools to operate a STEM (science, technology, engineering and mathematics) Academy to increase Māori student engagement in STEM programmes. Pūhoro seeks to support secondary schools to prepare their Māori science students for transfer to tertiary study and from there into employment. The Academy has had significant success in improving Māori educational performance rates:

- Ninety-eight percent of Pūhoro Year 11 students passed at least one science achievement standard.
- Ninety-two percent of the 2016 Pūhoro student cohort continued in the Year 12 Pūhoro programme and participated in science courses at NCEA level 2.
- In 2017, 92% of Pūhoro Year 12 students achieved at least one science external achievement standard.

This report provides a cost benefit analysis (CBA) of the *potential* economic benefits of the Pūhoro Academy. Due to the limited data available and the relatively short time the programme has been operating for, the CBA takes a conservative approach to estimating the value of the Academy to the students over their working life. The Pūhoro Academy is improving Māori NCEA achievement rates. The CBA considers in the counterfactual that there is a cohort of Pūhoro students who would not have been expected to pass NCEA in the absence of the Academy. It is this cohort, representing the difference between the average Māori NCEA pass rate and the Pūhoro Academy pass rate, that represent the economic benefits of the Academy.

As the CBA is estimating potential future economic benefits, there is a degree of uncertainty in quantifying these economic benefits. The CBA therefore establishes a likely scenario, based on past Pūhoro Academy performance data, as well as three additional scenarios, all of which make more conservative predictions.

Based on the success of Pūhoro for Y11 students, the Pūhoro programme is assumed to increase pass rates for its students by 30% above the national average for Māori students undertaking the same level of qualification in the same year. A second more conservative impact for the Pūhoro programme of 15% increases in pass rates is also analysed to test the sensitivity of the CBA.

The following table below summarises four different CBA scenarios over a forty-year working career. In all cases the Pūhoro Academy covers its costs by a factor of 1.2 to 3.2 times

	NCEA Qualifications, 30% Pūhoro Impact	NCEA Qualifications only, 15% Pūhoro Impact	NCEA + Tertiary Qualifications, 30% Pūhoro Impact (Primary Analysis)	NCEA + Tertiary Qualifications, 15% Pūhoro Impact
	40-Year NPV \$m			
Total marginal impact	3.26	3.14	8.98	7.53
Total cost of initiative	2.82	2.82	2.82	2.82
Net economic benefits	0.45	0.32	6.16	4.72
	40-Year NPV \$			
Net economic benefit per cohort member (40y)	\$4,018	\$2,924	\$55,501	\$42,496
CBA Ratio	1.2	1.1	3.2	2.7

The CBA utilises multiple conservative assumptions which potentially undervalue the benefits of the programme. Despite this, the Academy covers its costs under even the most conservative scenarios tested. The analysis provides an illustration of the power of a successful intervention in a young person's life. The analysis also highlights the significant benefits that are possible through tertiary education. While covering costs, the Pūhoro Academy has little significant impact if it is assumed that students will not go on to higher levels of qualifications after completing NCEA. The Pūhoro Academy could add significant value to its students by facilitating a transition to further education. It is understood that this is the Academy's intention.

The Pūhoro Academy is delivering economic benefits above its costs. These benefits are being realised by students obtaining qualifications that they would not have been likely to obtain in the absence of the Pūhoro Academy. It is likely that the benefits considered in this analysis will ripple out through whānau, both in the present and in the future. The AgriBusiness Group has not attempted to quantify these ripple effects, which reinforce the conclusion that considerable value is being created through this initiative. Additionally, the sometimes-conservative assumptions used throughout the report likely underestimate the direct economic impacts that Pūhoro has on its students. If the Academy were to continue to support students through tertiary education,

significantly higher economic benefits could be achieved. Further, the focus on STEM subjects is likely to amplify these benefits further.

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## 1 Introduction

In September 2018 The AgriBusiness Group was subcontracted by ESR to perform a cost benefit analysis (CBA) of Massey University's Pūhoro STEM Academy. The AgriBusiness Group sought to provide an analysis of its economic impact, taking into account guidelines published by the New Zealand Treasury. This report presents the details of The AgriBusiness Group's analysis. This report provides a conservative Cost Benefit Analysis (CBA) for the Pūhoro Academy. The proposal for the CBA stated that:

*The focus of the CBA will be on quantifying the lifetime earnings of an individual based on their potential educational achievement.*

It is expected that there are multiple economic benefits that will accrue to participants due to their participation in the Academy, particularly in regard to Pūhoro's STEM focus and the subsequent higher salaries that careers in these fields can bring. However, the programme is recently established, and future economic benefits cannot yet be accurately determined. Therefore, the CBA presented in this report makes conservative assumptions to demonstrate the impact of the Pūhoro Academy even in the absence of the additional significant economic benefits the programme is likely to create.

### 1.1 Structure of the report

This report presents the results from The AgriBusiness Group's analysis. Chapter 2 describes the Pūhoro Academy and provides some background information on the participants, it also highlights limitations in the data available on which the Academy was assessed. Chapter 3 describes way in which the cost benefit analysis was designed and the data that were used. This description has been written for a general audience. It focuses on the ability of the Pūhoro Academy to improve Māori NCEA achievement rates above the national Māori average. It also describes the way in which the

economic impacts of the Pūhoro Academy were quantified. Chapter 4 presents the results of the analysis. The net present value as at 30 October 2018 of potential economic benefits from increased qualifications being achieved by three Y11 cohorts of students in the academy is estimated to be above \$8,980,000. A total cost of approximately \$2,800,000 was ascribed to the three cohorts. Thus, the analysis finds that Pūhoro has the potential to return over 3 times its cost in economic benefits.

## 2 The Pūhoro Academy

As noted in the introduction, the Pūhoro Academy has been selected for analysis because it specifically aims to invest in the economic potential of its participants through educational development, which can be expected to produce lifetime benefits. This chapter describes this initiative. Section 2.1 draws on Pūhoro reports to introduce the initiative. Section 2.2 provides some descriptive data about the participants in the programme. Section 2.3 summarises the outcomes achieved by the participants as at October 2018.

### 2.1 The Pūhoro Academy Overview

The Pūhoro programme is best described by the 2017 Pūhoro Annual Report:

In January 2016, NASA Aerospace Engineer and Pūhoro Ambassador, Mana Vautier (Te Arawa, Tūhourangi, Ngāti Kahungunu), together with Astronaut Col. Rick Searfoss officially launched Massey University's Pūhoro STEM Academy. Since then, Pūhoro has grown in strength to now offer places for more than 450 Māori students across four regions.

Pūhoro ... is an exciting transformative programme aimed at advancing Māori leadership and capability to deliver a world class science community. The programme works directly with secondary school students and their whanau across the country. It provides students and whanau with mentoring, tutoring, wānanga (experiential learning/field trips) within culturally appropriate settings to help them navigate career pathways into science and technology related industries.

Pūhoro commences with a three-year programme (Years 11 – 13) within secondary school. The Pūhoro Academy partners with a selection of secondary schools from the Manawatū, Bay of Plenty and South Auckland regions to operate a STEM (science, technology, engineering and mathematics) Academy to increase Māori student engagement in STEM programmes. Pūhoro seeks to support secondary schools to prepare their Māori science students for transfer to tertiary study and from there into employment.

All students selected to be a part of Pūhoro are required to participate in and sit a minimum of three of the required external science achievement standards at National Certificate of Educational Achievement (NCEA) Level 1, 2 and 3. They are also required to attend Pūhoro at wānanga at Massey University each term. The Academy has many aspects to engage with students including career mentoring, study noho, wānanga, tutorials, expo’s, study/exam workshops, and kaihautū mentoring.

## 2.2 The Participants in Pūhoro

The Pūhoro Academy is recently established, and data on the success of the participants are still limited. However, Pūhoro staff have stated that in 2016, 75% of students were not on an academic pathway (and therefore did not intend to enrol in external science achievement standards). The AgriBusiness Group was provided the following table of information on the Pūhoro students’ numbers and pass rates for the past three years (Table 1.)

**Table 1. Information on Y11 NCEA achievement of Pūhoro students**

	Pūhoro Student Numbers	Pūhoro Pass Rates (%)	National Pass Rate (%)
2016	97 (Y11)	98%	82% (Y11)
2017	110 (Y11) 80 (Y12)	92%(Y11), not available(Y12)	78% (Y11), 79% (Y12)
2018	160 (Y11) 93 (Y12)	No data available	No data available

*Data provided by the Business Development Manager and the Business Manager – Pūhoro Academy Programmes.*

Students enter the Academy in Y11 so that the benefits from participation are potentially enjoyed for a working life of four decades. This observation is a significant aspect of the cost benefit analysis in Chapter 4.

## 2.3 Outcomes achieved by the participants

The Pūhoro Academy has had significant success in improving Māori educational performance rates, some key achievements include:

- Ninety-eight percent of Pūhoro Year 11 students passed at least one science achievement standard (this includes internal achievement standards). This is a significant achievement for Pūhoro students resulting in an increase of Māori student achievement in science subjects.
- Ninety-two percent of the 2016 Pūhoro student cohort continued in the Year 12 Pūhoro programme and participated in science courses at NCEA level 2. While improving Māori participation in STEM subjects, the Pūhoro program is also significantly enhancing overall Māori NCEA pass rates.
- The 2017 Year 11 cohort had a wide range of career aspirations. Many of the students identified engineering, marine biology and physiotherapy as aspirations.
- According to Pūhoro informational resources, Pūhoro students achieved a high-level of merit and excellence endorsements for individual external achievement standards.
- In 2017, 92% of Pūhoro Year 12 students achieved at least one science external achievement standard.

### 3 Economic Benefits of Pūhoro

The purpose of this chapter is to explain the mechanisms by which the Pūhoro Academy produces economic benefits. Section 3.1 brings together the data from Chapter 2 on the previous and current situations of the participants. Section 3.2 presents the income data used in the cost benefit analysis of the following section.

#### 3.1 Impact of the Pūhoro Academy

The analysis is based on three Y11 cohorts as it is these groups for which the highest quality data are available. Table 2 below provides an overview of the 367 students upon which the economic benefits are estimated.

**Table 2. Improvements in pass rates from the Pūhoro intervention**

Year	Pūhoro Students (n)	Pūhoro Pass Rate (%)	Pūhoro Students Passed (n)	National Māori Pass Rate (%)	Expected pass without Pūhoro (n)	Pūhoro intervention difference (n)	Pūhoro Intervention Difference (%)
2016	97	98%	95	65.60%	64	31	33% increase
2017	110	92%	101	64.20%	71	30	30% increase
2018	160	95%	152 <i>(estimated)</i>	64% <i>(estimated)</i>	102 <i>(estimated)</i>	50 <i>(estimated)</i>	30% increase <i>(estimated)</i>
Total	367		348		237	<b>111</b>	

*Data on Pūhoro provided by the Business Development Manager and the Business Manager – Pūhoro Academy Programmes. Data on National Māori Pass Rates from NZQA (2018a).*

The following conservative assumptions have been made about the Pūhoro students.

- The students included in the model represent the difference between the national average pass rates for Māori Y11 NCEA students and the Pūhoro students Y11 NCEA pass rates. Students that are in the Pūhoro Academy but would have been assumed to have passed Y11 without the Pūhoro intervention are not included. This will likely underestimate the impact of Pūhoro, as the students brought into the program are likely to gain exposure to knowledge in STEM fields which could provide significant future benefits.
- It is assumed that students who do not pass Y11 NCEA have gained no economic benefit from their participation in the Academy

Data are not available on the overall pass rates of the Y12 and above Pūhoro students. The analysis is therefore conducted only for Y11 students, following them through three years of the Pūhoro program. As it is too early to determine the future pass rates of these students, previous Pūhoro student pass rates and national average pass rates for Māori students are used to estimate likely future pass rates. Based on the success of Pūhoro for Y11 students, the Pūhoro programme is assumed to increase pass rates for its students by 30% above the national average for Māori students undertaking the same level of qualification in the same year. A second more conservative impact for the Pūhoro programme of 15% increases in pass rates is also analysed to test the sensitivity of the CBA.

The economic benefits of the students' educational achievements will only be realised in the future. Thus, the analysis will determine the *potential* economic benefits on the assumption that those currently engaged in the Pūhoro programme will complete a range of education achievements in accordance with the assumptions described in Appendix A.

### 3.2 The income data used in the analysis

The New Zealand Treasury (2018) provides a spreadsheet model for social cost benefit analysis along with other resources offering guidance for analysts using this tool. This CBAX model incorporates a list of publicly available New Zealand data that organisations can use to value the impacts of an intervention such as the Pūhoro programme. The Impacts Database of the Treasury's CBAX model includes impacts on marginal annual income data categorised by qualification level rebased to 2017 values. The following economic impacts (Table 3) are attributed to the Pūhoro programme to different degrees (attribution explained in Appendix A - additional information on impacts in Appendix B).

**Table 3. CBAX impacts used to determine economic benefits**

<b>CBAX Row Number</b>	<b>Description</b>	<b>Value (p.a.)</b>	<b>Sector</b>
<b>159</b>	100% of Marginal value - No qualification to NCEA level 3	2,085	Private Impact
<b>160</b>	100% of Marginal value - No qualification to Other school	1,553	Private Impact
<b>163</b>	100% of Marginal value - NCEA level 3 to Tertiary degree	17,859	Private Impact
<b>162</b>	100% of Marginal value - NCEA level 3 to Other post school	9,865	Private Impact
<b>180</b>	100% of Income tax and ACC levy: Marginal value - No qualification to NCEA level 3	486	Revenue
<b>181</b>	100% of Income tax and ACC levy: Marginal value - No qualification to Other school	362	Revenue
<b>184</b>	100% of Income tax and ACC levy: Marginal value - NCEA level 3 to Tertiary degree	7,303	Revenue
<b>183</b>	100% of Income tax and ACC levy: Marginal value - NCEA level 3 to Other post school	3,646	Revenue

## 4 Results of the Cost Benefit Analysis

Cost benefit analysis is first and foremost an organising principle. It is a way of organising information in a consistent and systematic way. It is about making best use of whatever information is available. It is about evidence-based policy development.

Gabriel Makhoulouf  
Secretary to the Treasury  
(Treasury, 2015, p. 3)

This chapter uses resources provided by Treasury (2015, 2018) to undertake a consistent and systematic cost benefit analysis of the Pūhoro Academy, using information available at October 2018. The analysis also takes direction from Dalziel et al. (2017) *Measuring the Economic Impact of Whānau Ora Programmes: He Toki ki te Mahi Case Study*, who estimate the economic benefits of a Māori trade skills training programme.

It begins in section 4.1 by describing the counterfactual; that is, the assumed outcomes in the absence of the Pūhoro Academy. Section 4.2 presents a detailed account of how the potential economic benefits of the initiative have been calculated, including an explanation of the ‘discount rate’ used. Section 4.3 then presents the estimated economic costs. Section 4.4 reports the results of a sensitivity analysis, examining the impact of changing key assumptions in the cost benefit analysis. Section 4.5 considers the impact of the programme beyond what is quantified in the analysis.

### 4.1 The counterfactual

The Guide to Social Cost Benefit Analysis explains that the counterfactual is the situation that would exist if a policy does not go ahead (Treasury, 2015, p. 9). In this case, the counterfactual can be derived from the 2017 Annual Report (Pūhoro, 2017, p. 4):

“The prevailing narrative is such that Māori students are over-represented among the proportions of lower performing students in science programmes within secondary schools. Furthermore, of those that do participate in science programmes, Māori are less likely to sit external science assessments. All Pūhoro students are required to participate in external achievement standards for science courses...Ninety-two percent of the Pūhoro 2016 student cohort continued with sciences at NCEA level 2 – despite the highest drop-out rate for Māori students in science occurs between NCEA level 1 and NCEA level 2.

As the program is relatively new and not enough time has passed for students to progress from the programme to the work force, it is not possible to determine which STEM fields students may enter. The analysis is conservative in that it assumes that economic benefits will accrue to students based on the average marginal benefits per annum from different qualification levels. There are 111 Y11 Pūhoro Academy students who meet this requirement. This will likely underestimate the economic value of the Pūhoro programme as STEM professions tend to attract higher than average salaries.

Consequently, the assumed counterfactual is that in the absence of Pūhoro, a participant would gain no economic benefit from their participation in the Pūhoro programme, but would return to their likely previous career path of a person without a secondary school qualification. The counterfactual is therefore the difference between average NCEA pass rates for Māori students, and NCEA pass rates for Pūhoro students.

To keep the analysis conservative, it is assumed that students who are not expected to pass a qualification level will get no future benefit from higher educational achievements.

## 4.2 The estimated potential economic benefits

The 111 students Table 2 analysed in this chapter can be grouped into four categories of participants, all of which contribute to the estimated potential economic benefits. To reiterate, the

analysis only includes students who would not have been expected to achieve any level of qualification in the absence of the Pūhoro programme.

- 21% of participants will achieve NCEA Levels 1 or 2 (CBAX Impact 160)
- 52% of participants will achieve NCEA Level 3 (CBAX Impact 159)
- 9% of participants achieve a non-degree level post school qualification (CBAX Impact 162)
- 18% of participants will achieve a bachelor's degree (CBAX Impact 163)

The potential economic benefits come from the 111 students who are on a higher income path due to the qualifications they have obtained. Students who are not expected to pass NCEA 1 or would have been expected to pass in the absence of the Pūhoro programme are not included in the analysis. Based on their age group (Y11 students), it is possible to calculate for the remaining years of their working life the marginal income benefits assumed in the counterfactual. For those students who finish their education after achieving NCEA Levels 1 or 2, these marginal income benefits are assumed to begin two years after their first participation in Pūhoro. For students who finish their education after achieving NCEA Level 3, this benefit will begin after three years, and for those students who go onto undertake a post school qualification, this benefit will begin after seven years.

Because the intervention is targeting young people, the economic benefits continue for a long time, up to 40 years. Hence the total benefits to a participant are substantial. Second, larger gains come from successful completion of higher levels of qualifications. Pūhoro has not been running for long enough to obtain any information on its completion rates. This is why the analysis refers to the initiative's *potential* economic benefits.

This report follows Dalziel et al. (2017 p.20) in the selection of an appropriate discount rate, they state:

To calculate the total net present value of these benefits, it is necessary to determine a suitable discount rate, acknowledging “that most people would prefer receiving a dollar today over receiving a dollar in a year’s time” (Treasury, 2015, p. 34). This preference is linked to interest rates earned on savings, and so the discount rate is set to reflect current interest rates and the risks of social investment of this nature. The discount rate recommended by [Treasury (2018)] is 6 per cent, which is the rate used in this study.

Based on these assumptions, the total net present value of the potential economic benefits at 30 October 2018 is calculated by The AgriBusiness Group to be above **\$8,970,000**.

### 4.3 The estimated economic costs

Information on costs for the programme was limited to a single budget sheet for 2017. This was used to derive a cost of \$2982 per student per annum. As only overall pass rates for Y11 students were provided, the analysis follows each cohort of Y11 students across three years of study. Due to the high pass rates (between 95-98%) the analysis takes a conservative approach in assuming that the costs for each student in Y11 will remain through to Y13. This is likely to overestimate costs as some students will drop out of the programme. Additionally, marginal costs are likely to decrease with every additional student (e.g. Cohort 3 Table 4), however, the analysis conservatively uses a flat rate for the cost of each student across all years.

All the fixed costs are assigned to the current cohort of participants, although it is hoped that the initiative will continue to operate with new entrants as time proceeds. This represents another conservative assumption in the analysis.

The costs are attributed to the following three cohorts of Pūhoro Academy students:

- Cohort 1 – 97 Students – Impact based on 31 student difference to average
- Cohort 2 – 110 Students - Impact based on 30 student difference to average
- Cohort 3 – 160 Students - Impact based on 50 student difference to average

The costs based on the 2017 costs of \$2982 per student per annum and then adjusted based in the CBAX model to reflect the appropriate years adjustment factor (Table 4).

**Table 4. Estimated costs of the Pūhoro Academy for three Y11 cohorts over five years**

NCEA	2016	2017	2018	2019	2020
Y11	Cohort 1	Cohort 2	Cohort 3		
Y12		Cohort 1	Cohort 2	Cohort 3	
Y13			Cohort 1	Cohort 2	Cohort 3
Student total	97	207	367	270	160
Total Costs (inflation adjusted)	\$280,948	\$565,613	\$946,039	\$656,600	\$367,072
<b>Estimated total cost of programme for 367 students across five years</b>					<b>\$2,816,272</b>

Based on the assumptions made above, the total net present value of the economic costs associated with participants at 1 November 2018 is calculated to be \$2,816,272

This cost is well below the estimated net present value of potential economic benefits in Section 4.2 (above \$8 million). Thus, the Pūhoro initiative is producing potential economic benefits beyond its costs.

#### 4.4 Sensitivity analysis

The cost benefit analysis reported in sections 4.2 and 4.3 suggest that the net potential economic benefits of the Pūhoro Academy is **\$8,970,000 - \$2,816,272 = \$6,153,728**.

The final step in a cost benefit analysis is to reflect on whether the assumptions in the analysis have unintentionally incorporated an 'optimism bias', leading to overestimation of future benefits or underestimation of costs (Treasury, 2015, p. 31). The alternative is to consider pessimistic scenarios to understand the sensitivity of the result to key assumptions (Dalziel et al. 2017).

It was assumed that the Pūhoro Academy can increase its students NCEA achievement rates by 30% based on past performance results. It was also assumed that some students (in line with national averages) would continue to higher levels of education after completing NCEA Level 3. Table 5 considers four potential outcomes, three of which are more conservative than the primary analysis.

1. NCEA Qualifications only, 15% Pūhoro Impact – this scenario is highly conservative and assumes a 15% impact from Pūhoro, with no students continuing to higher education.
2. NCEA Qualifications, 30% Pūhoro Impact – this scenario also assumes no students will continue to higher education but includes a 30% impact.
3. NCEA + Tertiary Qualifications, 15% Pūhoro Impact – this scenario assumes that some students will continue to higher education, but that Pūhoro will only have a 15% impact on achievement rates.
4. NCEA + Tertiary Qualifications, 30% Pūhoro Impact (Primary Analysis) – this is the primary scenario used in this report.

The 15% impact scenario is explained in more detail in Appendix A.

**Table 5. Sensitivity analysis of four scenarios of Pūhoro’s impact**

	NCEA Qualifications, 30% Pūhoro Impact	NCEA Qualifications only, 15% Pūhoro Impact	NCEA + Tertiary Qualifications, 30% Pūhoro Impact (Primary Analysis)	NCEA + Tertiary Qualifications, 15% Pūhoro Impact
	40-Year NPV \$m			
Total marginal impact	3.26	3.14	8.98	7.53
Total cost of initiative	2.82	2.82	2.82	2.82
Net economic benefits	0.45	0.32	6.16	4.72
	40-Year NPV \$			
Net economic benefit per cohort member (40y)	\$4,018	\$2,924	\$55,501	\$42,496
CBA Ratio	1.2	1.1	3.2	2.7

Table 5 shows that in all cases the Pūhoro Academy covers its costs by a factor of 1.2 to 3.2 times. As explained earlier, the primary analysis is likely to underestimate the benefits of the Pūhoro Academy in different ways, mainly:

- It assumes average Māori completion rates for tertiary study and does not incorporate a likely ‘Pūhoro effect’ for these students.
- It assumes that Pūhoro students will enter university at the same rate as the average Māori student (i.e. 50% of those students who complete Y13 NCEA). Again, the Pūhoro Academy is likely to increase this rate.
- It does not account for students entering higher than average salaried professions. As Pūhoro is focused on STEM learning, and as STEM fields can attract higher than average

salaries, it is likely the Pūhoro students could earn higher salaries in the future than the CBA predicts.

The greatest economic impacts in the analysis are realised through tertiary study. As the Pūhoro Academy has not been operating long enough to follow students through a tertiary study path, there is too much uncertainty in attempting to quantify their potential impacts. Section 4.5 however, provides some discussion on what these impacts may be.

Despite the conservative assumptions used in the CBA, the Pūhoro academy covers its costs under all scenarios considered and provides a significant economic benefit under the primary scenario. Hence the fundamental conclusion of the analysis, that the Pūhoro Academy is generating a positive economic impact is robust.

#### 4.5 Impacts beyond NCEA achievement

The NZQA (2018b) has stated that:

We...partner with education agencies to support a goal of a 50% lift of Māori and Pasifika student achievement at NCEA Level 3 in one or more standards in STEM subject related areas by 2020 An example of this is the supporting Massey University Pūhoro Academy of Science.

This report has used a more considered the economic impacts of the Pūhoro Academy meeting this challenge and found them to be significant. However, the CBA makes some conservative assumptions to compensate of an optimism bias. The Pūhoro students however show no such tentatively.

Fifty-four Pūhoro students provided information on the future jobs they hoped to get. These have been grouped in Table 6 by the likelihood that a tertiary qualification would be required to obtain the job. The majority of students (85%) indicated a desire for jobs that would likely, or may require, a tertiary qualification, the most selected job being 'doctor'.

**Table 6. Future job preferences for Pūhoro students**

<b>Tertiary Qualification Likely Required</b>	<b>Tertiary Qualification May be Required</b>	<b>Tertiary Qualification Unlikely to be Required</b>
Doctor (7)	Business (3)	Professional Sportsperson (2)
Physiotherapist (6)	IT (2)	Soldier (2)
Engineer (4)	Art	Joiner
Teacher (3)		Adventure Tourism Guide
Science (3)		Mechanic

Architect (3)		Truck Driver
Biologist (3)		
Psychologist (2)		
Food Technology		
Forensic Criminologist		
Forensic Scientist		
Ecologist		
Chemistry		
Marine Biologist		
Pilot		
Lawyer		
Veterinary Nurse		
<b>74 % (n40)</b>	<b>11% (n6)</b>	<b>15% (n8)</b>

The report assumed that the Pūhoro students would follow national averages for Māori students with 50% of Y13 NCEA graduates entering a tertiary course, and from that 50%, only 67% would be expected to enter a bachelor's degree programme. This represents on 18% of the Pūhoro cohort. However, Table 6 above suggests that at least 74% of Pūhoro students have expressed a desire to follow a career path that would likely require the attainment of a bachelor's degree. The CBA uses a marginal impact of \$19,944 p.a. for the attainment of a bachelor's degree (plus NCEA Level 3) while the attainment of NCEA Level 3 alone attracts a marginal impact of only \$2,085p.a. While it is too early for there to be any supporting data, the performance improvements demonstrated by Pūhoro and the aspirations expressed by Pūhoro students suggest that significant economic impacts could be achieved by the Academy.

Each student who goes on to receive a bachelor's degree after leaving the Pūhoro Academy will generate over \$200,000 NPV over a 40-year career. If this student were to complete a post-graduate qualification, this figure rises to over \$300,000. Costs were estimated at \$2982 per student per annum, if the Pūhoro Academy can support students, who were not on an academic pathway, through to higher levels of education, there is the potential that the Academy could generate significantly higher net economic benefits than those presented in this report.

## 5 Conclusion

The cost benefit analysis of the Pūhoro Academy reported in sections 4.2 and 4.3 calculates that the potential economic benefits outweigh the economic costs by a factor above 3.2 to 1. The analysis is an illustration of the power of a successful intervention in a young person's life; in this case, the initiative has the potential to increase the lifetime earnings of 111 students. For those students who go on to complete a bachelor's degree, the Pūhoro Academy is assumed to have a marginal impact on their lifetime earnings by over \$200,000 NPV. The sensitivity analysis reveals that even at a more conservative impact rate of 15% the potential economic benefits outweigh the economic costs by a factor above 2.7 to 1. This more conservative assumption would still result in over \$40,000 extra income per student over their working career.

The sensitivity analysis in section 4.4 indicates that the results from the cost benefit analysis are robust. The Pūhoro Academy is delivering economic benefits above its costs. These benefits are being realised by students obtaining qualifications that they would not have been likely to obtain in the absence of the Pūhoro Academy. It is likely that the benefits considered in this analysis will ripple out through whānau, both in the present and in the future. Section 4.5 discussed some of these benefits at a high level. The AgriBusiness Group has not attempted to quantify these ripple effects, which reinforce the conclusion that considerable value is being created through this initiative. Additionally, the sometimes highly conservative assumptions used throughout the report likely underestimate the direct economic impacts that Pūhoro has on its students. If the Academy were to continue to support students through tertiary education, significantly higher economic benefits could be achieved. Further, the focus on STEM subjects is likely to amplify these benefits further.

## 6 References

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## Appendix A - Deriving Percentage Impacts for the Cohorts based on 2016 example.

### **Model 1. Highly Conservative – No Tertiary Education. Percentage of cohort receiving each impact derived from a 2016 example.**

- The Pūhoro program is expected to increase Māori student NCEA pass rates by 30% above expected pass rates for Māori students without the intervention.
- 97 Students enter the program in Y11
- 98% pass leaving – 95 students continue to Y12 (2 students receive no benefits from Pūhoro)
- These 95 students represent the cohort for which Pūhoro has an impact known hereafter as the Pūhoro cohort.
- 95% of students pass Y12 – 90 students continue to Y13. Pass rates for Y12 students are, on average, higher than for Y11 students<sup>1</sup>. The average Pūhoro pass rates for Y11 students are therefore assumed to be applicable for Y12 Pūhoro students (data on Y12 Pūhoro students pass rates is not available).
- 5 % of students (n5) from the Pūhoro Cohort benefit from achieving Y11 but no more (Impact 160 CBAX)
- Of the 90 students who go on to Y13 84% are expected to pass. National pass rates for Māori students in Y13 are on average 54% based on 2016 and 2017 data<sup>1</sup>. The Pūhoro programme is expected to increase pass rates by 30% (i.e. 84%). 75 students are therefore expected to pass Y13, **this represents 79% of the Pūhoro Cohort who will receive Impact 159 in the CBAX model.** Fifteen students will not pass and will benefit from achieving Y12 only.

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<sup>1</sup> Annual Report on NCEA and New Zealand Scholarship Data and Statistics (2017)

- The 5 students who stop at Y11 and the fifteen students who stop at Y12 are covered by the Impact 160 in the CBAX model. **These 20 students comprise 21% of the Pūhoro Cohort in the model who will receive Impact 160 in the CBAX model.**

### Model 1 Percentage Impacts

CBAX Impact Reference	% of Pūhoro Students Receiving Impact
Impact 159	79%
Impact 160	21%
Total	100%

### Model 2. Primary Analysis - Percentage of cohort receiving each impact derived from a 2016 example.

- National statistics can be used to consider the likelihood that students will continue to future education. The model assumes that every student in the Pūhoro Cohort would not have achieved Y11 and would therefore derive no marginal benefits from additional education. Average national statistics can therefore be applied to the Pūhoro Cohort who achieve Y13 NCEA to estimate their likely benefits.
- The second model extends the first assuming **that 21% of the cohort (n20) will receive only impact 160 CBAX**
- Of the 79% of students who achieve Y13 NCEA, statistics suggest that 50% of Māori students will go on to some form of tertiary education<sup>2</sup>.
- The model assumes 37 students will go on to further study, while 38 students will receive only the impact from Y13 NCEA qualifications.
- Of these 37 students who continue their study, 37% (n13) will go on into non-degree courses (Levels 1-7) while 67% (n24) will go into a degree programme<sup>2</sup>.
- Seventy five percent (n9) are expected to pass their level 1-7 qualifications<sup>3</sup>, this represents **9% of the Pūhoro cohort who are expected to achieve impact 162 CBAX**. The remaining 4 students are added to the 38 students in the Y13 NCEA achievers, bringing this group to a total of 42 students.

Of the 24 students who go into a degree programme, 74% are expected to pass<sup>3</sup>. **This represents 17 students or 18% of the cohort who are expected to achieve impact 163 CBAX**. The remaining 7

<sup>2</sup> <https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/1907>

<sup>3</sup> [https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/completion\\_of\\_tertiary\\_qualifications](https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/completion_of_tertiary_qualifications)

students are added to the Y13 NCEA achievers' group, bringing this to a total of 49 students or **52% of the Pūhoro Cohort who will receive Impact 159 in the CBAX model.**

#### Model 2 Percentage Impacts

CBAX Impact Reference	% of Pūhoro Students Receiving Impact
Impact 159*	52%
Impact 160	21%
Impact 163	18%
Impact 162	9%
Total	100%

\*Students who receive impacts 162/163 also receive impact 159

#### Model 1-1 – Sensitivity test – 15% Impact – No Tertiary Education

- The Pūhoro program is expected to increase Māori student NCEA pass rates by 15% above expected pass rates for Māori students without the intervention.
- 97 Students enter the program in Y11
- 80% of students pass Y12 – 76 students continue to Y13
- 20% of students (n19) from the Pūhoro Cohort benefit from achieving Y11 but no more (Impact 160 CBAX)
- Of the 76 students who go on to Y13 69% are expected to pass. 52 students are therefore expected to pass Y13, **this represents 55% of the Pūhoro Cohort who will receive Impact 159 in the CBAX model.** 24 will not pass and will benefit from achieving Y12 only.
- The 19 students who stop at Y11 and the 24 students who stop at Y12 are covered by the Impact 160 in the CBAX model. **These 43 students comprise 45% of the Pūhoro Cohort in the model who will receive Impact 160 in the CBAX model.**

#### Model 1-1 Percentage Impacts

CBAX Impact Reference	% of Pūhoro Students Receiving Impact
Impact 159	55%
Impact 160	45%
Total	100%

#### Model 2-1 – Sensitivity test – 15% Impact – Tertiary Education

- The second model extends the first assuming **that 45% of the cohort (n43) will receive only impact 160 CBAX**

- Of the 55% of students (n52) who achieve Y13 NCEA, statistics suggest that 50% of Māori students will go on to some form of tertiary education<sup>4</sup>.
- The model assumes 26 students will go on to further study, while 26 students will receive only the impact from Y13 NCEA qualifications.
- Of these 26 students who continue their study, 37% (n9) will go on into non-degree courses (Levels 1-7) while 67% (n17) will go into a degree programme.
- Seventy five percent (n7) are expected to pass their level 1-7 qualifications<sup>5</sup>, this represents **7% of the Pūhoro cohort who are expected to achieve impact 164 CBAX**. The remaining 2 students are added to the 26 students in the Y13 NCEA achievers, bringing this group to a total of 28 students.
- Of the 17 students who go into a degree programme, 74% are expected to pass. **This represents 13 students or 14% of the cohort who are expected to achieve impact 163 CBAX**. The remaining 4 students are added to the Y13 NCEA achievers' group, bringing this to a total of 32 students or **34% of the Pūhoro Cohort who will receive Impact 159 in the CBAX model**.

#### Model 1-2 Percentage Impacts

CBAX Impact Reference	% of Pūhoro Students Receiving Impact
Impact 159*	34%
Impact 160	45%
Impact 163	14%
Impact 162	7%
Total	100%

\*Students who receive impacts 162/163 also receive impact 159

<sup>4</sup> <https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/1907>

<sup>5</sup> [https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/completion\\_of\\_tertiary\\_qualifications](https://www.educationcounts.govt.nz/statistics/indicators/main/education-and-learning-outcomes/completion_of_tertiary_qualifications)

## Appendix B – Details of Economic Impacts Used in the Analysis

CBAx Row Number	Wellbeing Domain	Description	Value	Unit	Government/ Non-Government	Sector	Year of data	Source (1)	Source (2)	Explanation and Calculations
159	Jobs & earnings	100% of Marginal value - No qualification to NCEA level 3	1,982	Per year	Non-Government	Private Impact	2015	<a href="#">Statistics New Zealand Income Survey, 2015</a>	This work is based on/includes customised Statistics New Zealand's data which are licensed by Statistics New Zealand for re-use under the Creative Commons Attribution 3.0 New Zealand licence.	Marginal value from increased income of NCEA level 2 compared with no qualification (net of government transfers)
160	Jobs & earnings	100% of Marginal value - No qualification to Other school	1,476	Per year	Non-Government	Private Impact	2015	<a href="#">Statistics New Zealand Income Survey, 2015</a>	This work is based on/includes customised Statistics New Zealand's data which are licensed by Statistics New Zealand for re-use under the Creative Commons Attribution 3.0 New Zealand licence.	Marginal value from increased income of other school compared with no qualification (net of government transfers)
163	Jobs & earnings	100% of Marginal value - NCEA level 3 to Tertiary degree	16,978	Per year	Non-Government	Private Impact	2015	<a href="#">Statistics New Zealand Income Survey, 2015</a>	This work is based on/includes customised Statistics New Zealand's data which are licensed by Statistics New Zealand for re-use under the Creative Commons Attribution 3.0 New Zealand licence.	Marginal value from increased income of tertiary qualification compared with NCEA level 2 (net of government transfers). Tertiary qualification is taken as a Bachelors degree, the lowest level tertiary qualification
164	Jobs & earnings	100% of Marginal value - Other school to Other post school	9,884	Per year	Non-Government	Private Impact	2015	<a href="#">Statistics New Zealand Income Survey, 2015</a>	This work is based on/includes customised Statistics New Zealand's data which are licensed by Statistics New Zealand for re-use under the Creative Commons Attribution 3.0 New Zealand licence.	Marginal value from increased income of other post school compared with other school
180	Civic engagement	100% of Income tax and ACC	462	Per year	Government	Revenue	2015	<a href="#">Inland Revenue, 2017/18</a>	<a href="#">ACC earners' levy, IRD 2017</a>	Marginal value from increased income tax and ACC levies of NCEA level 3 compared with no

	& governance	levy: Marginal value - No qualification to NCEA level 3								qualification (net of government transfers)
181	Civic engagement & governance	100% of Income tax and ACC levy: Marginal value - No qualification to Other school	344	Per year	Government	Revenue	2015	<a href="#">Inland Revenue, 2017/18</a>	<a href="#">ACC earners' levy, IRD 2017</a>	Marginal value from increased income tax and ACC levies of other school compared with no qualification (net of government transfers)
184	Civic engagement & governance	100% of Income tax and ACC levy: Marginal value - NCEA level 3 to Tertiary degree	6,942	Per year	Government	Revenue	2015	<a href="#">Inland Revenue, 2017/18</a>	<a href="#">ACC earners' levy, IRD 2017</a>	Marginal value from increased income tax and ACC levies of tertiary qualification compared with NCEA level 3 (net of government transfers). Tertiary qualification is taken as a Bachelors degree, the lowest level tertiary qualification
185	Civic engagement & governance	100% of Income tax and ACC levy: Marginal value - Other school to Other post school	3,584	Per year	Government	Revenue	2015	<a href="#">Inland Revenue, 2017/18</a>	<a href="#">ACC earners' levy, IRD 2017</a>	Marginal value from increased income tax and ACC levies of other post school compared with other school