National SCIENCE Challenges

Centre for High-Value Nutrition

HIGH-VALUE NUTRITION

Ko Ngā Kai Whai Painga

Annual Plan 2016/17

May 2016

Host Institution

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNIVERSITY of OTĀGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

agresearch

Plant & Food RESEARCH
RANGAHAU AHUMĀRA KAI

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EXECUTIVE SUMMARY

Following a short establishment phase in 2014, the 10 year plan for the High-Value Nutrition National Science Challenge (HVN) was approved by the government's Science Board in March 2015 and a contract executed between the Ministry of Business, Innovation and Employment and the University of Auckland (as Challenge Contractor or host) for funding through to mid-2019. The revised Business and Science Plans for HVN can be found on the HVN web site here (http://www.highvaluenutrition.co.nz/en/resources/relevant-HVN-documents.html). This is the base plan for HVN.

Responsibility for performance of HVN is devolved to a Challenge Board established by the University of Auckland in collaboration with its partner Challenge Members (AgResearch, Plant & Food Research, Massey University and the University of Otago) under a Collaboration Agreement.

Over the past year the focus of HVN has been on initiating and contracting research – both the longer term science platforms (which are called Priority Research Programmes or Projects) included in the revised Business and Science Plans, and shorter term and more narrowly focused Research Projects awarded via a contestable process open to all New Zealand research organisations.

Progress has also been made in engaging with stakeholders – both aligned researchers and relevant businesses. This culminated in the inaugural HVN Science Symposium held in April this year.

This Annual Plan outlines the focus for the year ahead in the context of the overall strategy for HVN and the timeframes of the current contract period to mid-2019. The Annual Plan 2016/17 represents an update on the approved Business and Science Plans.

As well as providing an overview of the strategic approach the Challenge is taking and a status update on existing investments this Annual Plan outlines the goals and activities planned for the year (and years) ahead. In simple terms the focus for 2016/17 related to the following goals:

- Strengthening Research Excellence;
- Refreshing our approach to Vision Mātauranga;
- Building a National Science Challenge Culture and Team;
- Expanding our Stakeholder Engagement activities;
- Developing an International Profile for HVN;
- Supporting development of Regulatory Approvals for food health claims;
- Extending our Communications and Marketing reach.

STRATEGIC CONTEXT AND CURRENT STATE OF CHALLENGE

The Food and Beverage sector generates the largest volume and value of New Zealand's merchandise exports at $30.7B in 2014, being rivalled only by the growth in the non-merchandise tourism sector.

The Food and Beverage sector is being challenged to contribute to growing the ratio of exports to GDP to 40% by 2025 as part of the government's Business Growth Agenda (currently under 30% with little change over recent years). Much of this will need to come from the growing export markets across Asia and especially China. This level of revenue growth cannot be achieved by productivity gains alone and requires that the sector derives greater value from the products exported. The Government's 2015 refresh of the Business Growth Agenda to 2025 notes that a significant lift in export performance is required to meet the 40% target:

> *We therefore need a greater focus on adding more value to volume: building on our traditional primary sector strengths to capture greater value-add and supporting the development of high value, premium, knowledge-intensive businesses.*

A recent NZIER report (Agriculture and food and beverage GVC policy considerations, January 2016) described the underlying issue of New Zealand as the need to generate more domestic value added from enhanced participation in global value chains or networks. The ability to capture value increases by shifting towards the consumer which involves investment in intangible assets such as human capital, brand development, science and innovation and consumer connection (see recent presentations from Ian Proudfoot, KPMG). This is counterintuitive to New Zealand's historical focus on investment in tangible assets supporting greater productive capacity.

There are many ways to add value to foods that consumers will pay more for. One of the strongest and most enduring value-add strategies derives from the relationship consumers perceive between foods and their health and wellbeing.

The government has identified this as a key growth opportunity for New Zealand and has both strengthened the regulatory framework relating to food health claims and created the High-Value Nutrition National Science Challenge (HVN) to support the sector exploit this opportunity.

Cabinet has approved a simple objective for HVN:

> *To develop high-value foods with validated health benefits to drive economic growth*

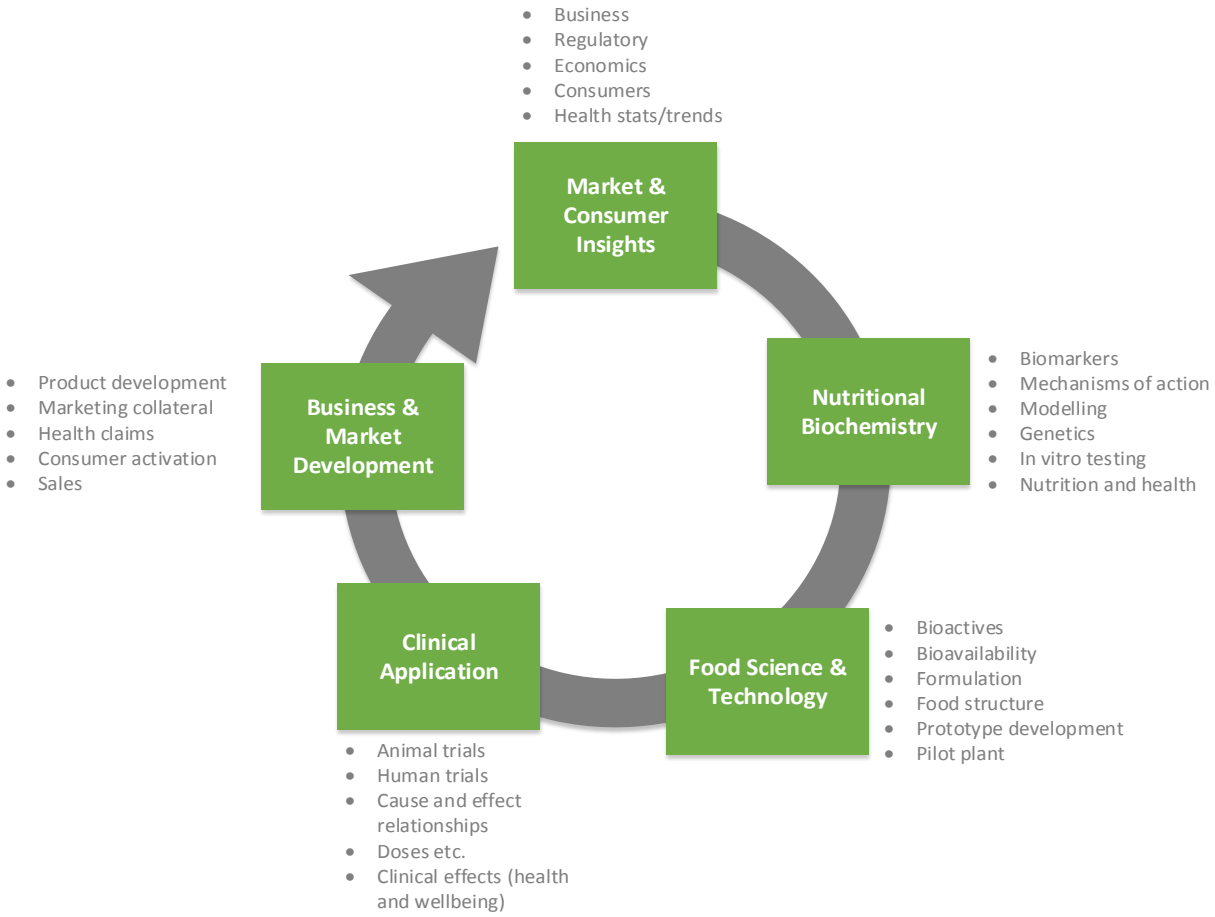
HVN was launched in April 2014 and has developed a strategic approach focused on understanding the nutrition related health and wellbeing concerns of consumers in our export markets (with a strong focus on Asia/China) and building the science capabilities to define the nutrition responsive markers relevant to those concerns. This will support the design, development and marketing of foods with scientifically validated health benefits.

The overall strategic framework for HVN is outlined in the following table and identifies the high level goals for HVN in 2016/17 that are the basis for this Annual Plan.

High-Value Nutrition Strategic Framework

FOCUS	STRATEGY	2016/17 GOALS
Vision: Growing New Zealand food and beverage export revenue by $1b p.a. by 2025 through international leadership in the science of food and health relationships. **Mission:** The overarching objective of the HVN Challenge is to develop high-value foods with validated health benefits to drive economic growth through research excellence in the following research themes: - **Clinical application** (demonstration of a health or wellbeing benefit from a food consumed by humans); - **Biomarkers** (defining the biomedical mechanisms and indicators for the food health relationship); - Meeting **consumer preferences** for and motivations to purchase healthy foods; - **Food science** and technology (ensuring the foods deliver the health benefit to consumers). The aim of the HVN Challenge is to increase the value of New Zealand food exports by improving the value proposition to consumers through a health claim on the food leading to increased premiums and/or increased sales volume. Research under all themes will be relevant to the health targets, regulatory needs, consumer preferences/values, and the food types that offer the greatest economic opportunity to New Zealand through food exports. **Scope:** To achieve this mission, HVN will: - Establish a virtual centre of excellence; - Support research, science or technology or related activities to achieve the mission; - Focus on the health relationships of food and beverage products; - Focus on operations suitable to food and beverage products as defined by FSANZ.	1. Investing to build world-leading research capabilities in food-health relationships that provide the platforms for future product and market innovation	Strengthen **Research Excellence**
	2. Investing in novel science and innovation opportunities	
	3. Building researcher skills and expertise in the science of high-value nutrition, including Māori researchers, that will catalyse development of evidence based health foods	**Vision Mātauranga** Refresh Build **Culture and Team**
	4. Coordinating and leveraging research across New Zealand that is aligned to High-Value Nutrition to ensure it is mutually reinforcing achievement of the mission	Expand **Stakeholder Engagement**
	5. Developing pathways for research translation and engagement to enable New Zealand industry to increase economic returns through the development and marketing of evidence based health foods	
	6. Actively engaging with leading international organisations and research groups relevant to High-Value Nutrition to access regulatory knowledge, research capabilities, build relationships and influence	Develop **International** Profile
	7. Aggregating, integrating and communicating scientific knowledge relevant to the priority consumer health targets to become an internationally recognised authority in food-health relationships and health claims	Supporting **Regulatory** Approvals Extend **Communications and Marketing**

The overall innovation dynamic is illustrated in the following diagram:



Central to this is to try to generate a consumer pull philosophy supported by strong science and business drivers in designing the core research platforms (what we describe as our Priority Research Programmes). This is in contrast to the New Zealand business as usual product and or technology push philosophy. The Priority Research Programmes were included in the Research Plan approved by the Science Board and contracted by MBIE in mid-2015. Following validation by industry and negotiation of performance based contracts the initial suite of five Priority Research Programmes (including two preliminary projects) commenced in October 2015.

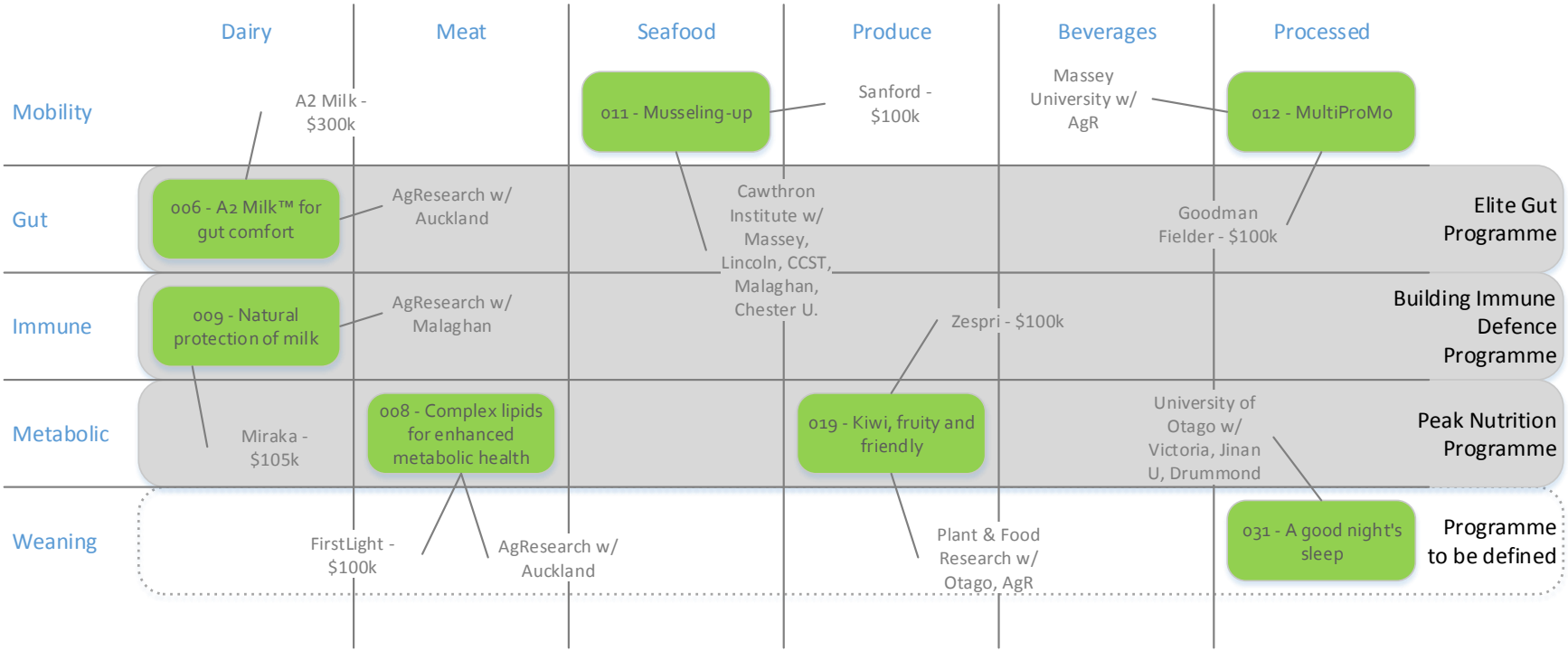
This approach will allow HVN to both build and consolidate the science capabilities that will be able to be used by businesses to design, develop and validate the health benefits of food products. As this occurs, issues of supporting market development, consumer activation and regulatory approval of claims or marketing collateral will

become relatively more important. To ensure HVN is learning and supporting business through to the market we have invested in a series of product/market focused research projects via the initial contestable funding round.

From 33 applications, HVN has selected and invested in seven focused Contestable Projects – all of which commenced in early 2016.

This gives HVN a balanced portfolio of both precompetitive research (developing science capabilities that will benefit multiple businesses) and contestable research (focused on defined product/market/business opportunities)

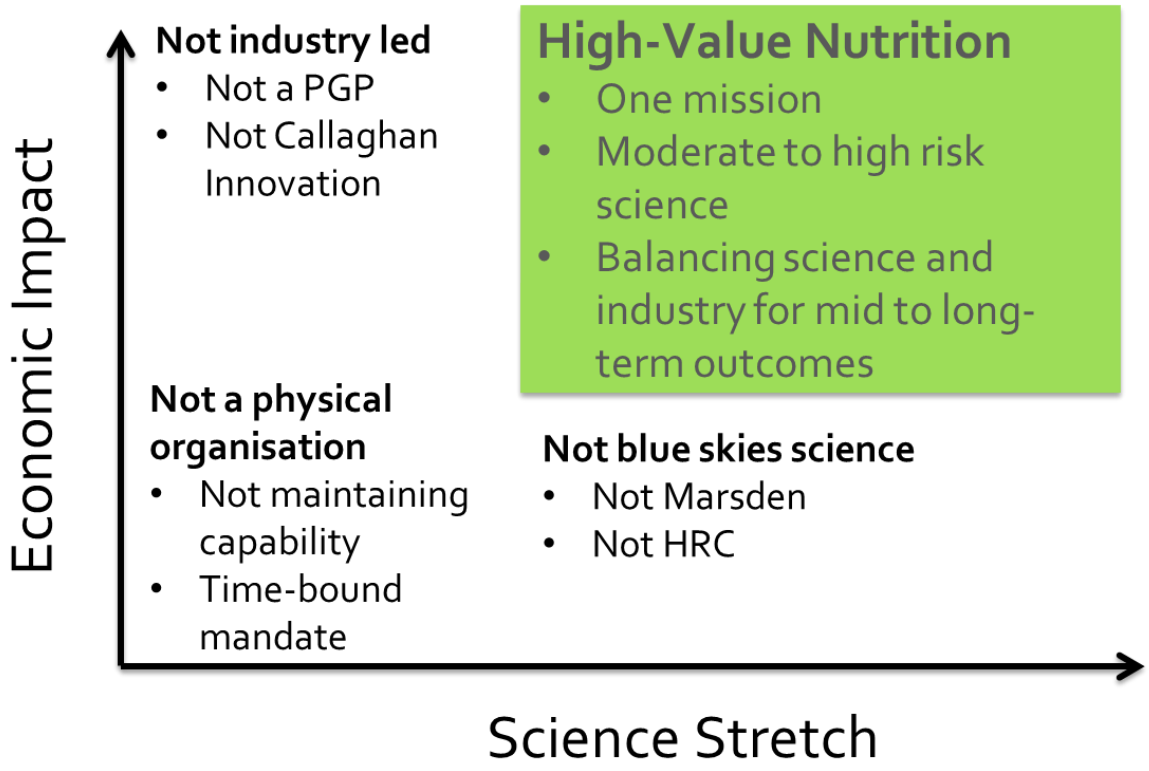
The current portfolio of research is illustrated in the following diagram which outlines the sectoral and consumer health alignment of the investments:



Note: The portfolio also includes preliminary "scanning/stocktake" projects on the Science of Foods and Consumer Insights.

Current status and short updates/descriptions of each programme and project are included in Appendices 1 and 2.

Underpinning the HVN investment philosophy is a strong commitment to the positioning of National Science Challenges to bring about change and that complement but extend other investments – what the government variously describes as not business as usual or additionality. This has driven us to seek a balance across our investments of science excellence or stretch and economic impact. The relationship of HVN to other innovation investments in New Zealand is illustrated below:



Within this framework the Priority Research Programmes are taking the longer term view and greater risk but with potential to create greater economic impact through supporting multiple business and product opportunities. They will also generate the science credibility to position New Zealand as a leading centre of excellence in the science of food and health. The Contestable Projects are still taking moderate risk, are of high science quality but are seeking a shorter path to market with a narrower product/ business focus.

With these investments in place HVN is now able to look ahead at how it achieves its mission. This requires it goes beyond the role of an investor to be a change agent for the New Zealand Food and Beverage sector and its related science sector.

Building to 2025

HVN is aiming to support a New Zealand wide endeavour (NZ Inc.) to add value to food and beverage exports through scientifically validated health benefits for consumers. In doing so, HVN is not only aiming to stimulate greater revenues from New Zealand food and beverage exports but also to establish New Zealand as a leading country for evidence-based validation of food health relationships.

The long term aspirational target for HVN is to support development of additional export revenue to New Zealand of >$1B p.a. in New Zealand origin foods and beverages with scientifically validated health benefits based at least in part on HVN funded or aligned research and related activities by 2025.

In addition, HVN has a secondary long term target to demonstrate that New Zealand's international reputation as a food producer of high quality foods with scientifically validated health benefits is enhanced.

The impact of HVN on these targets will derive in three main ways – directly resulting from HVN funded research, from aligned research in NZ research organisations and from related research and development occurring in NZ F&B businesses that is influenced by HVN activities.

The overall result is intended to be a transformative step change for the NZ Food and Beverage sector creating a new vertical sector of foods with scientifically validated health benefits of similar magnitude to the wine industry (if not by 2025 then by 2030). These three components will develop in parallel but differently as outlined in the following paragraphs.

The HVN funded research will progress through a series of precompetitive research programmes and a set of contestable projects in the first funding period to 2019. The intention of the pre-competitive programmes is to build the science capabilities and to establish food component / health relationships which can be leveraged by multiple businesses in the following period to 2024. As a result it is not intended that these programmes will directly support export revenues by 2019 (If they did that would be business as usual and not set the Challenge up for the transformative step change by 2025). The contestable projects arising from the first RfP will, however, be focussed on progressing concepts or innovations to a point that businesses can invest to move them quickly to market. The contestable projects will run from 2016 to 2018. First revenues from these investments should thus start to occur in 2019 and contribute to the $250M projected in the KPIs for 2024 rising to around $350M in 2025 as the sponsored research focuses increasingly on products, markets and human validation studies in the second funding period.

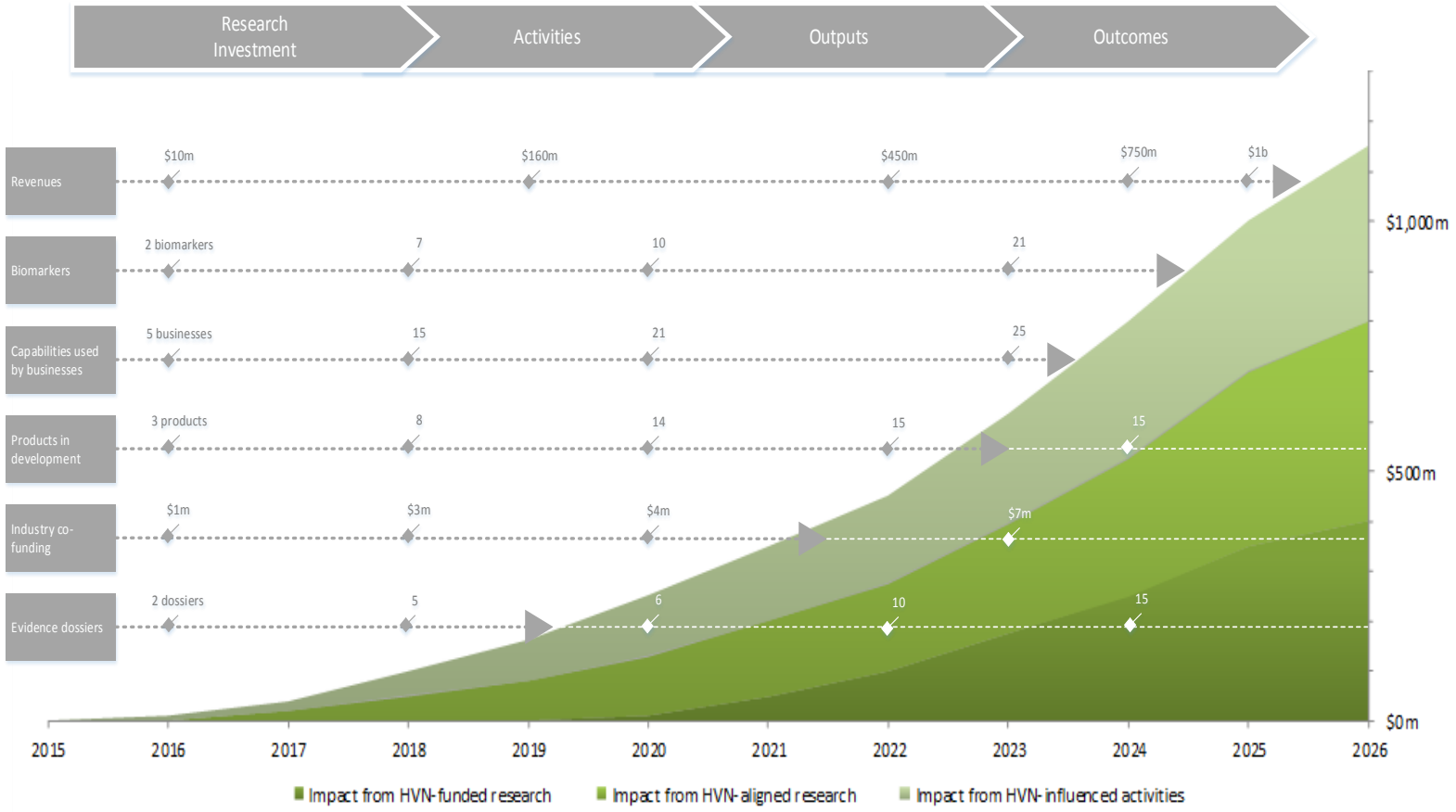
Aligned research, however, is already under way and can be expected to start supporting export revenues much sooner. Given the final KPI is based on additional revenues then any sales from products currently in market are excluded. We intend to develop methodology to estimate the value of export revenues that fit the HVN description over the next year and use 2014/15 to establish the baseline from which growth is measured. Any new revenues from aligned research could start as early as 2016 and should be expected to build throughout the period to 2025. We anticipate revenues supported by aligned research will be similar in magnitude to those from directly sponsored research building to around $350M in 2025.

Beyond the funded and aligned research we see HVN stimulating additional related research and development in F&B businesses in several ways – firstly by building research capabilities through the funded and aligned research than can be directly leveraged by businesses in their product and market development activities. This will be measured by the business investment in "HVN capabilities" initially. On top of this HVN will provide a suite of expert services to businesses – regulatory and science advice, brokering services to build project teams, early access to research results and novel Intellectual Property, expertise and support in the building of evidence dossiers

and related marketing collateral. These activities will support businesses own in-house research and development on products and marketing campaigns that will generate a further stream of revenue. This activity will necessarily take time to build but should be supporting new revenues by 2018 and an estimated further $300M pa by 2025.

The combined contributions from HVN funded, aligned and related research activities are thus intended build to the $1B pa aspirational target in 2025 as illustrated in the figure below.

Export revenues are a lag indicator of HVN success. The key lead indicators that demonstrate likelihood of achieving the lag indicator include those measuring biomarkers/evidence dossiers/industry investment in capabilities/ product and market development of foods with validated health benefits - building off the prior research activities. The relationship of these lead indicators and the building of export revenues is also illustrated in the figure below.



PROGRESS UPDATE

During its Establishment Phase from April to December 2014, the focus of the Challenge was on:

- initiating stakeholder plan;
- defining and designing its Revised Business and Science Plans;
- defining investment focus areas
- establishing an operational head office;
- establishing a board.

Following approval and contracting of the second Challenge Programme Agreement the focus of the Challenge from April 2015 to June 2016 was on implementing the Revised Business and Science Plans through:

- Contracting the majority of the Priority Research;
- Running a request for proposal and contracting the contestable research;
- Defining and agreeing the Challenge's Key Performance Indicators;
- Building the Challenge's profile;
- Engaging with stakeholders including the science community and the Food and Beverage business sector
- Initiating a "Challenge culture".

The Challenge held its first Science Symposium in April 2016 where the progress to date was presented.

Our overall progress to plan for 2015/16 is summarised against our seven core strategies in the following table:

STRATEGY	Status	
1. Investing to build world-leading research capabilities in food-health relationships that provide the platforms for future product and market innovation		The implementation of the science plan submitted to MBIE in December 2014 was the focus of 2015/16: - HVN has invested $10.9m in 5 Priority Research programmes, 3 focussing on consumer-driven health targets (gut, immune and metabolic health), and 2 supporting projects (food science and consumer insight). Those programmes are designed to build capabilities and generate new knowledge that will future-proof New Zealand. - Complementary to the Priority Research programmes, HVN has invested $7m in 7 novel and innovative projects through its contestable call, which are designed to engage more closely with industry and bring innovations to the market in the mid-term. The initial science plan had identified another Priority Research programme, Weaning food-for-health. The programme is still being assessed for the best investment opportunity and the associated regulatory risks. Note - The second phase food science and consumer insight programmes are in development to follow the initial projects.
2. Investing in novel science and innovation opportunities		
3. Building researcher skills and expertise in the science of high-value nutrition, including Māori researchers, that will catalyse development of evidence based health foods		Through its Priority Research and Contestable Call HVN has been successful in breaking the silos between science fields, particularly between medical and food fields, both relevant to food-for-health. HVN has formed both multidisciplinary and integrated teams, bringing together and creating relationships between scientists that previously were not working together. This forms the foundation of a strong long-term New Zealand capability in food-for-health. Unfortunately HVN hasn't been as successful in meaningfully engaging with Māori researchers, and this will remain a focus for the year to come.
4. Coordinating and leveraging research across New Zealand that is aligned to High-Value Nutrition to ensure it is mutually reinforcing achievement of the mission		For 2015/16 HVN has focused on building its profile within the science community and identifying research aligned to its mission. HVN identified 69 capabilities, 51 distinct projects and 140 researchers that are aligned to the challenge.
5. Developing pathways for research translation and engagement to enable New Zealand industry to increase economic returns through the development and marketing of evidence based health foods		HVN has defined the foundations for its industry engagement, and will build on those over the next year: - In addition to its Industry Advisory Panel (which plays a strategic role), HVN has

		implemented more operational industry reference groups for each of its Priority Research programmes to ensure relevance of its research outputs. - Out of 7 contestable projects HVN has funded 6 projects that have cofounding from and are strongly associated with F&B businesses. - HVN has created a network of business managers that will be the entry point for industry to access the national "HVN capability" (i.e. HVN funded capability and aligned capability).
6. Actively engaging with leading international organisations and research groups relevant to High-Value Nutrition to access regulatory knowledge, research capabilities, build relationships and influence	●	HVN's Priority Research programmes are internationally linked, and the Challenge has built strategic relationships with regards to accessing regulatory knowledge. However international relationships have not been the focus of the Challenge to date and this area will be a priority for 2016/17.
7. Aggregating, integrating and communicating scientific knowledge relevant to the priority consumer health targets to become an internationally recognised authority in food-health relationships and health claims	●	In 2015/16, HVN has established its profile nationally and has built the communications tools to reach internationally (mostly through videos). However building an international profile has not been a focus to date and this area will be a priority for 2016/17.

● not started
● on track
● achieved
● at risk
● not achieved

The bulk of the Challenge's research has now started and each Priority Programme has reported on its initiation. Initial reports from the Contestable Projects will be received at end June.

The details of the investments made and their status as known at end of May is detailed in Appendix 1 and 2.

Overview of the High-Value Nutrition research portfolio and investments

INVESTMENTS OVERVIEW	VALUE	PERIOD
MBIE investments in High-Value Nutrition		
- Establishment Phase (contracted)	$600k	April – December 2014.
- **High-Value Nutrition Phase 1 (contracted)**	**$30m**	**April 2015 – June 2019**
- High-Value Nutrition Phase 2 (committed but dependant on MBIE's 2019 performance review)	$53.2m	July 2019 – June 2024
High-Value Nutrition investments (Phase 1 April 2015 – June 2019)		
- Priority Research (contracted)	$10.9m	October 2015 – March 2019
- Priority Research (committed and budgeted)	$5m (total)	(expected periods)
- Consumer Insight	$1.5m	July 2016 – March 2019
- Food Science	$1.5m	July 2016 – March 2019
- Weaning Food	$2m	January 2016 – March 2019
- 1st Round of Contestable Projects (contracted) The total value of the projects (including business and research organisations investments) is $8.7m	$7m	February 2016 – January 2019
- Special Projects (contracted)	$310k	June 2016 – June 2019
- Special Projects (budgeted, non-committed)	$290k	
- Contingency (budgeted)	$450k	
- Staff, Board, travel, marketing, communications, events (budgeted)	$6m	April 2015 – June 2019
Total	$30m	

RESEARCH INVESTMENTS	VALUE	PERIOD
Priority Research		
- GUT HEALTH - Improving Gastrointestinal Function and Comfort (contracted)	$3.6m	October 2015 – March 2019
- IMMUNE HEALTH - Building Immune Defence (contracted)	$3.5m	October 2015 – March 2019
- METABOLIC HEALTH - Peak Nutrition for Metabolic Health (contracted)	$2.9m	October 2015 – March 2019
- CONSUMER INSIGHT - Consumer Insight Project 1 (contracted)	$300k	October 2015 – September 2016
- FOOD SCIENCE - Scanning the Horizon (contracted)	$600k	October 2015 – June 2016
Contestable Research		
- a2 Milk™ for gut comfort (contracted)	$1m ($1.5m total value)	February 2016 – January 2019
- Complex lipids for enhanced metabolic health (contracted)	$1m ($1.1m total value)	February 2016 – January 2019
- Natural protection of milk (contracted)	$1m ($1.7m total value)	February 2016 – January 2019
- Musseling-up: high-value Greenshell™ musselfoods (contracted)	$1m ($1.1m total value)	February 2016 – January 2019
- MultiProMo (contracted)	$1m ($1.2m total value)	February 2016 – January 2019
- Kiwi, fruity and friendly (contracted)	$1m ($1.1m total value)	February 2016 – January 2019
- A good night's sleep (contracted)	$1m	February 2016 – January 2019
Total	$17.9m ($19.6m total value including businesses and research organisations co-investments)	

OUTLOOK TO 2019

The current Challenge Programme Agreement (CPA2) is for the period to end June 2019 with a total budget of $29,993,000. At that time the Ministry will review progress and determine whether to enter a further agreement (CPA3) for a further $54,000,000 for a five year period to end June 2025.

While the Vision/Mission and KPIs for HVN have the full 10 year outlook to 2024/25, the need to ensure HVN is recontracted by MBIE in 2019 necessitates the current strategic focus is on building the foundations for future success by 2019.

The full 10 year framework for HVN is outlined in the diagram below. It envisages three distinct forms of research investment with the initial focus being:

Priority Research Programmes

Precompetitive research to build the science base and capability for future opportunities across multiple businesses

Contestable Projects

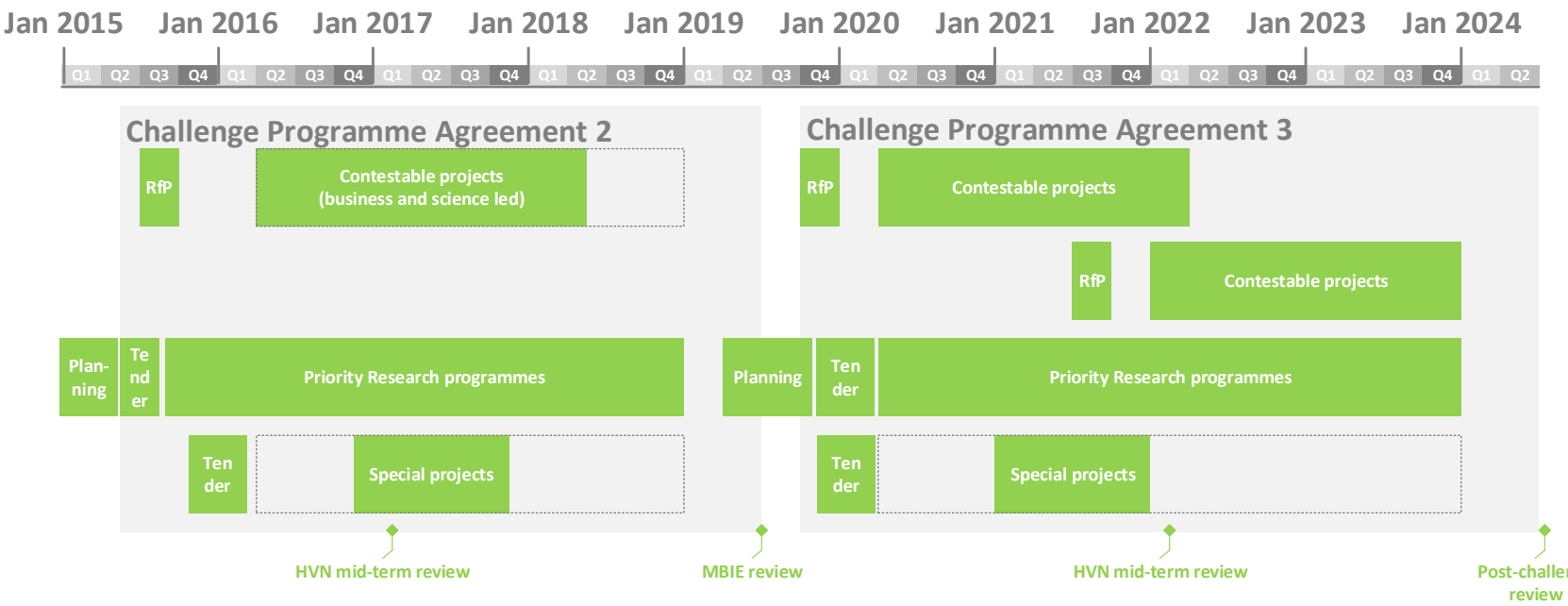
Shorter term projects with a defined end point which leads to business investment in the next innovative step

Special Projects/Contingency

Things that need doing to advance the Challenge including scanning/stocktakes of existing knowledge/measuring and tracking HVN impact

The focus for these may change in the 2019/24 period.

Our approach to establishing HVN in the current period (2015/19) has been to move quickly to contract the Priority Research Programmes and Special Projects included in the Research Plan approved by the Science Board and to conduct an early Contestable Funding round to build early engagement with the wider science ad business community. The early contracting of research will also generate results prior to the MBIE review in 2019. The indicative plan for the 2019/24 period is to repeat this model but, with the additional funds and time available, to run two contestable funding processes.

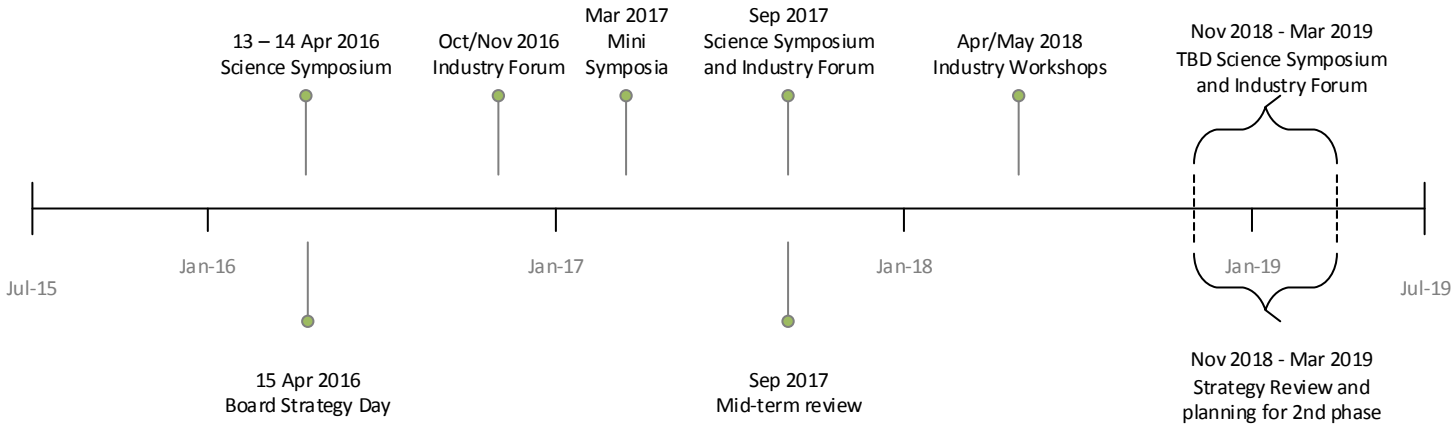


With the initial investment portfolio now contracted HVN has been able to focus its efforts on its additional roles and strategies. While these are dynamic we have defined a series of structured engagements/events and meetings through to 2019 to ensure HVN is constantly engaging and reviewing progress with both external stakeholders and internal advisors – including the international Science Advisory Panel, Industry Advisory Panel along with the HVN Board , Science Leadership Team and HVN Management. We have recently held our first Science Symposium as part of the programme of external events and coupled it with an internal Strategy Day that focused on how HVN can build on what has been achieved to date and lift to a higher level of performance. Many of the ideas for activities and initiatives included later in this Annual Plan derived from the Strategy Day.

Later this year we intend to hold a one day industry forum to strengthen relationships with the Food and Beverage business sector.

To ensure HVN remains on track to a successful review by MBIE in 2019 we intend holding an internal mid term review in late 2017 and couple this with the next major external event – a combined Science Symposium and Industry Forum.

These national level events will be supported by more narrowly focused or thematic events via mini-symposia and workshops. The overall plan for these meetings and events is outlined in the following diagram:



This Annual Plan should be seen within the context of the plan through to 2019. The focus for 2016/17 being on continuing to build the broader roles of a National Science Challenge beyond its role as a research investor.

FOCUS FOR 2016/17

Goals for 2016/17

What we aim to achieve	Why is this important now	What we are going to do	How we will know we are succeeding
Stakeholder Engagement (SE): Enhanced understanding of and buy in by stakeholders to the HVN mission and strategic approach	To build a broader coalition for change and commitment to growing New Zealand's food export revenues through the validation of their health benefits for consumers	Establish and implement a stakeholder engagement plan	Through positive improvement in the stakeholder survey between 2016 and 2017
Communications and Marketing (CM): Raised profile of HVN within New Zealand	To build a greater awareness of and buy in to the strategic approach of HVN to create momentum	Undertake a national campaign to promote HVN in relevant fora/meetings / events	Invitations to present at a diverse range of NZ meetings and feedback following the engagement
International (Int): Raised profile of HVN in international science fora	To create awareness of the potential and point of difference of HVN to generate relevant collaborations and influence	Initiate an international campaign involving targeting key international events/meetings to hold HVN mini-symposia and identify centres of excellence to build strategic linkages with	Plan and implement model to support a structured programme of international engagements over the period to 2019 in place with any events/interactions scheduled in 2016/17 completed successfully
Regulatory (Reg): Develop service model for supporting businesses with their short term needs	Businesses have immediate needs and limited experience / expertise in designing, developing and marketing foods with validated health benefits that needs addressing to avoid wasted effort and to enhance prospects for positive outcomes	Establish a referral arrangement with leading consultancies to provide initial feedback to businesses on go to market issues for foods with health benefits coupled with expert "authoritative" advice on the nutritional science required to meet regulatory evidential standards	Through the numbers of businesses taking up the "service" and their feedback on its value
Vision Mātauranga (VM): Work with and learn from innovative Maori food and beverage businesses	Maori provide a potential competitive advantage for NZ food exporters through the heritage value they bring and the collective approach to business that may be able to be leveraged into foods for health	Work with Poutama Trust (which is part of the Nuku ki te Puku group that is working through Callaghan Innovation) to explore options to establish a Maori "HVN" business cluster	Successful creating of an HVN Maori business cluster or subcluster and active participation by a viable cohort of Maori businesses
Research Excellence (RE): Investment to build high quality research	Need to complete research investments and manage performance to ensure	Complete processes for outstanding science investments and complete annual	Performance of investments against plan

capabilities	potential for early impact	and mid-year reporting on all investments with appropriate quality assurance controls	
Culture and Team Work (CTW): Build a coalition of researchers and businesses aligned with the Mission	HVN needs to build a national agenda and momentum for change that goes beyond the investments it makes	Hold industry forum and a series of mini symposium to build relationships and understanding across the team, businesses and aligned researchers	Attendance at HVN events and feedback from participants

Changes

What is the planned change	Why is this happening now	What is the intended benefit	How will the impact of the change be measured
CTW: Recruitment of new management staff including Challenge Director and Chief Scientist	Recruitment of the Directors were deferred from 2015 due to changes in the leadership model from a single to a dual leadership model.	Stronger business management and science leadership of the Challenge	Stakeholder feedback and quality and timeliness of delivery against plan

Key Activities and Initiatives

What we are going to do (link to goals)	Why is this important	How we are going to do it	How we will measure our success
RE: Complete Phase 1 Research Investments in Science of Foods, Consumer Insights and Weaning Foods for Health	To ensure HVN is able to generate research led opportunities for the design, development and validation of foods with health and wellbeing benefits that consumers value	Use expert groups involving researchers and stakeholders to design and develop research programmes with input from industry and science advisors	Approval of research investments by the HVN Board and subsequent execution of research contracts
SE: Implement Food and Beverage exporters engagement plan	To build relationships with and buy in from the businesses that can assist HVN achieve its mission and ensure significant impact	Face to face meetings with ~ 30 businesses with potential alignment with the HVN mission	The proportion of businesses that seek follow up meetings to explore potential innovation opportunities with HVN
CM/SE/Int: Refresh website and develop marketing collateral	To support the stakeholder engagement plan and both national and international profile raising campaigns	Outsource to specialists who will work with key stakeholders and HVN staff to define needs and develop high quality resources	Delivery of a stakeholder oriented web site coupled with a suite of marketing materials for use in multiple settings
CM/SE/CTW: Develop and initiate a national profile raising campaign	To build awareness of and support for HVN across a wide range of	Identify key business , science and other meetings and seek opportunities to present/promote HVN	Numbers of events HVN is able to present or promote itself at and

	stakeholders		feedback from participants
Int: Develop and initiate an international profile raising campaign	To build awareness of HVN (and New Zealand food and health science) amongst influential international audiences	Identify prominent/high profile international meetings and seek to hold satellite mini-symposia / breakfast meetings/stands to promote HVN	Numbers of international events HVN invited to promote itself at
Int/SE: Identify multinational organisations that have the potential to collaborate with HVN for mutual benefit	To build bilateral awareness between HVN and MNCs with potentially aligned interests that may lead to future collaborative relationships	Identify and analyse MultiNational Organisations (including emerging and Asian organisations for potential strategic alignment with HVN and develop programme to build awareness and preparedness to engage	Clarity of potential MNC relationships and preparedness to engage
VM: Consider opportunity for Maori involvement	To leverage the integral part that Maori businesses play in the NZ Inc story	Work with Maori Food and Beverage collective groups to explore potential synergies	Establishment of effective working relationship with Maori F&B business groups or cluster
VM: Extend clustering model for working with small Maori businesses to other groupings	To realise benefits from Maori way of doing things as a possible NZ advantage	Explore opportunities for extending model for working with Maori business cluster to include a wider range of innovative but small F&B businesses	Defined approach to extend Maori clustering model out to other parties
SE: Explore opportunities to engage with micro organisations	To identify potential for disruptive or non-obvious innovation	Identify and assess emerging innovative micro businesses with potential for contributing to the HVN mission and plan to initiate engagement	Plan to initiate contact with micro businesses developed for implementation
SE: Develop and implement customised stakeholder survey	To supplement the very helpful Stakeholder Survey being conducted for MBIE with a more customised survey that will address HVNs needs	Develop and implement customised survey with selected F&B businesses	Survey completed and used to inform ongoing development of HVN stakeholder engagement
Reg/SE: Design and implement a service model for businesses	To provide readily accessible advice to businesses on the regulatory and science issues involved in developing and marketing foods with validated health benefits	Establish business relationship with leading international consultancy re providing services and advice to businesses wishing to enter global markets with "health" foods coupled with an arrangement with MPI re the NZ regulatory requirements. Supplement with service to provide an "HVN authoritative" assessment of the nutritional science involved in supporting or developing any health claims or benefits	Establishment of mechanisms for providing/accessing regulatory and science advice for businesses
SE: Hold national industry forum	To build greater understanding of and involvement of NZ F&B businesses with HVN	Design and hold HVN Industry Forum that responds to the needs of businesses relevant to HVN	Industry Forum held with good participation and feedback from businesses

CTW/SE: Hold theme specific mini symposia	To build greater involvement, buy in and learning across aligned researchers and interested businesses in research theme specific areas	Define and implement series of minisymposia in the health target areas of Metabolic Health, Immune Health and Gut Health	Series of mini-symposia held with positive participation and feedback from participants
Int/ RE: Identify and establish plan to engage with key international centres of excellence relevant to HVN	To access research capabilities not available in New Zealand and build the international profile of HVN	Define around 5 or 6 international centres of excellence that HVN should build a strategic relationship with for mutual benefit and establish plan to initiate engagement	Priority centres identified and plan established to initiate engagement
RE: Establish linkages with complementary New Zealand research collaborations	To access high quality science and stakeholder communities of potential benefit to HVN	Complete programme of meetings with Directors of relevant NSCs, CoRES and other national research collaborations to identify potential synergies and actions to leverage for mutual benefit	Meetings with relevant research collaborations completed with a suite of actions to leverage synergies agreed
CTW: Recruitment of key head office staff	To ensure continuity of operations and strategic development of the Challenge	Complete recruitment of Challenge Director, Chief Scientist, Operations Manager and Senior Communications and Marketing Advisor	Recruitment completed
RE: Monitoring of research investments	To ensure investments perform to plan	Review annual and mid-year reports (and any Stop/Go review reports) and manage performance actively	Achievement of high proportion of contracted milestones and objectives

Risks, Issues and Opportunities

What is the risk, issue or opportunity	How we are intending to respond	What is the possible impact	How we intend to manage the risk, issue or opportunity
Changes in management of the Challenge lead to changes in strategy	Complete recruitment of Challenge Director and Chief Scientist followed by Operations Manager and Senior Communications and Marketing Advisor	Delays in actioning this plan with consequent slowed momentum coupled with possible disruption from changes in direction	Completing recruitment as soon as possible and Board oversight of this Annual Plan and its implementation to ensure any changes are managed
Changes in food health claims regulations in key markets relating to weaning foods	Completing a business risk/opportunity analysis to identify where HVN science investment should be targeted	Delays in establishing investment in a significant opportunity area for New Zealand	Initiate assessment and research development process as soon as possible under the leadership of the incoming Chief Scientist
Provision of advisory services (or referrals) to businesses increases risk of complaints	Develop quality assurance processes for both referrals to external providers and internal sign-off of "HVN" advice	Potential complaints and even litigation re quality of advice received by businesses	Due diligence on external providers and multilevel assurance/sign-off of any advice provided under the HVN brand

Ability to run a second contestable investment process	Seeking options to have funds advanced by MBIE from the second funding period	Developing more commercialisation options earlier with learning for more businesses and researchers	Seek a contract change from MBIE

Performance Areas

Performance Area	Measure (Short title)	HVN Intentions in 2016/17 (re HVN investments – not including aligned research)
1. Delivery of the Challenge Objective	**1.1 Industry Validation of Research Plans**	Involve industry in development of outstanding investments
	1.2 Investment Performance to Plan	Monitoring and management of investments via annual and half year reporting
	1.3 Biomarkers	Too early
	1.4 Businesses using HVN Capabilities	Monitor business engagement in Contestable Projects and build relationships with Priority Programmes through Industry Reference Groups
	1.5 Products in Development	Too early
	1.6 Industry Co-Investment	Monitor cooinvestment in Contestable Projects
	1.7 Evidence Dossiers	Too early
	1.8 Revenues	Establish baseline data for 2014 and 2015
	1.9 International reputation	Conduct baseline survey
2. Science Quality	**2.1 Citation scores**	No new publications anticipated from HVN investments
	2.2 Citation index	No new publications anticipated from HVN investments
	2.3 Publications top quartile journals	No new publications anticipated from HVN investments
	2.4 International science reputation	Establish baseline via annual reporting
3. Best Research Team Collaboration	**3.1 Collaborative publications**	No new publications anticipated from HVN investments in 2016/17 year
	3.2 Research team effectiveness	MBIE survey will establish baseline
4. Stakeholder Engagement	**4.1 Stakeholder satisfaction re influence**	MBIE survey will establish baseline
	4.2 Stakeholder satisfaction knowledge exchange	MBIE survey will establish baseline
5. Maori Involvement and Mātauranga	**5.1 Maori stakeholders satisfaction re influence, engagement and value**	MBIE survey will establish baseline
	5.2 Investment in VM initiatives	Investments initiated via contestable projects
6. Effective Governance and Management	**6.1 Quality of Governance**	Will assess / review in August for inclusion in annual report
7. Public Participation	**7.1 Public Awareness**	Will continue to promote HVN events and news to the media

APPENDICES

1. Summary of current research investments
2. Status of current research investments
3. Summary of KPIs

Appendix 1 – Summary of current research investments

PRIORITY RESEARCH PROGRAMME	INVESTMENT	FOCUS
8. GUT HEALTH **Improving Gastrointestinal Function and Comfort** Led by Associate Professor Nicole Roy from AgResearch In collaboration with: - the Malaghan Institute - Plant & Food Research - the University of Otago	$3.6m over 3.5 years	The Gastrointestinal (GIT) Health investment priority will focus on the aspirational 'Elite Gut' of 'Worried Well' Asian consumers. The 'Worried Well' consumer represents the emerging middle and upper classes in Asia who want to excel as their careers and age advance. They will purchase food and beverage products to feel physically comfortable and immune fit, to stay mentally sharp and to slow cognitive decline. This is an economic opportunity for New Zealand that focuses on the wellness of the GIT and consumers' wellbeing. Food and beverage products that support work and play performance excellence for the 'Worried Well' are an under-exploited segment in the Asian market, with potential for strong growth in new, high value food and beverage product development with validated scientific claims. GIT health in Asia is among the leading health positions for market share and fastest growth worldwide and many functional food products are directed at these targets. There is an opportunity to market an 'Elite Gut' that is highly desired by 'Worried Well' Asian consumers to maintain optimal physical and mental performance in order to achieve their full potential and stay ahead of their peers. Investment will enable the consolidation of existing New Zealand capability and will result in the establishment of a New Zealand translational world class 'Elite Gut' research capability within New Zealand. It will also offer a unique opportunity for emerging scientists to develop their careers in New Zealand and continuous improvement of the tools and models that are critical for food-health claims. The specific focus of this research is to de-risk commercial opportunities for the New Zealand food and beverage sector, resulting in the development of food and beverage products with validated health claims designed to meet the needs of motivated Asian 'Worried Well' consumers; seeking to improve peak performance throughout the entire day, successfully manage stress responses and stay mentally sharp (the 'Elite Gut').
9. IMMUNE HEALTH **Building Immune Defence** Led by Dr Elizabeth Forbes-Blom from the Malaghan Institute In collaboration with: - Plant & Food Research - MRINZ - AgResearch	$3.5m over 3.5 years	An appropriately functioning immune system is essential for health and wellbeing, and impaired immunity effects physical and mental wellness resulting in diminished productivity. The desire to achieve and maintain economic success and status across generations in Asia drives the exceedingly high expectation of productivity and performance excellence in education and the workplace. The Building Immune Defence research programme will focus on these motivated consumers seeking food and beverage solutions to support immune defence against cold/flu infection and manage pollution driven respiratory inflammation for success in their daily lives. Frequent colds/flu are one of the top health issues worldwide, with influenza epidemics occurring virtually every year. The link between reduced overall productivity during respiratory tract infections is well recognised in the Asian market, and these motivated consumers demand solutions. The influence of nutrition on gut microbiota composition is a vital connection between diet and immunity, and the subsequent association with health status. Indeed, diet, antibiotic use and stress are known to alter gut microbiota composition, leading to reduced immune defence against respiratory tract infection. This research seeks to demonstrate the

		beneficial effects of New Zealand food and beverage products to restore appropriate host-microbiota interactions and build immune defence against influenza. Beyond respiratory tract infection, the significant rise in the ageing population that is susceptible to poor respiratory health is of major concern, and air pollution has become the fourth biggest threat to people's health in China. The rapidly increasing air pollution in China's major cities means these densely populated areas are considered 'barely suitable' for living. The respiratory immune system protects the body against inhaled pathogens and damaging particulate matter. In environments with high levels of air pollution, the lung immune system is under continued stress. This research will pursue the beneficial effects of food and beverage solutions to improve and support respiratory function in poor air quality environments through the management of inappropriate inflammation. This multi-disciplinary national research collaboration will provide increased scientific understanding of food-health relationships, and generate new opportunities for New Zealand companies to develop foods and beverages with scientifically validated immune defence benefits to increase market share and drive exports into Asia.
10. METABOLIC HEALTH **Peak Nutrition for Metabolic Health** Led by Professor Sally Poppitt from the University of Auckland In collaboration with: - the University of Otago - Plant & Food Research - AgResearch	$2.9m over 3.5 years	Weight gain and the poor metabolic health that develops as a consequence is rapidly becoming our most important global health condition. More than 1.5 billion adults worldwide struggle to control their weight and are now overweight or obese, with rates rapidly increasing throughout Asia including China where an estimated 30% of adults are struggling with their weight. Of these, 300 million have already been diagnosed with type 2 diabetes, the most common disease caused by overweight condition, and the numbers continue to rise. The Peak Nutrition for Metabolic Health [PANaMAH] program is focused on Asian consumers who are looking for nutritional solutions to maintain good metabolic health throughout middle and older age. In particular the 'overweight and over forties' looking to prevent diabetes and to support heart health. Perhaps surprisingly, when matched with people of the same gender, age and body weight, Asian consumers are at much greater risk of poor metabolic health than Europeans, Māori or Pacific people. This highlights the need for the design, development and marketing of food and beverage products that are positioned at the high-value end of their product categories by New Zealand exporting businesses focused on Metabolic Health. The reason why some individuals are more susceptible than others and what controls their diabetes risk may lie in the storage of body fat. Gaining even small amounts of weight can lead to the fat 'spilling over' from adipose tissue and into critical organs such as the muscle, liver and pancreas, which in turn may significantly increase risk of disease. Often known as TOFI – 'Thin on the Outside, Fat on the Inside' – ostensibly slim individuals can develop diabetes whilst those who are morbidly obese may be resilient. A national collaborative research team across New Zealand will be conducting clinical studies supported by advanced molecular techniques to ask questions such as 'who is most at risk and why?', 'what are the early markers of disease, and do they differ in those resilient to diabetes?', 'does lipid overspill matter?', and how can these problems be targeted by food and beverages, particularly in key consumer groups for New Zealand food exports to Asia. Type 2 diabetes is a nutritional disease, caused primarily through poor lifestyle, and is able to be both prevented and treated through better nutrition. Understanding the mechanisms through which the

		disease is caused will help us to target the widespread problem of adverse Metabolic Health with nutritional solutions that can be employed by New Zealand food and beverage exporters. The long-term aim of the Metabolic Health program is to fast track New Zealand companies in their development of validated food and beverage health claims, that both satisfy national and international regulators in terms of the scientific validity of the food health relationship, and which also ultimately appeal to the tastes of the Asian market.
11. CONSUMER INSIGHT **Consumer Insight Project 1** Led by Dr Roger Harker from Plant & Food Research In collaboration with: - the University of Auckland - the University of Otago - Pricewaterhouse Coopers	$300k over 1 year	Consumer insights are needed to help guide and prioritise opportunities in the High-Value Nutrition health domains. These insights will be delivered through targeted projects to address identified needs. They will also fulfil High-Value Nutrition's aspiration to collect insights that allow grounding of product-specific information in a broader understanding of the beliefs, attitudes, behaviours and lifestyles of Asian consumers that affect their choices of High-Value Nutrition foods and beverages. Use of these insights will guide development and help improve the success rate of High-Value Nutrition product launches and prevent significant economic losses associated with development and marketing of new products that subsequently fail in the marketplace. To achieve these goals in Year 1: consumer insights from the literature will be merged with pre-competitive knowledge available from New Zealand food and beverage companies, government-funded agencies and Asian academic organisations with a focus on food and health to provide early guidance and prioritisation of opportunities.
12. FOOD SCIENCE **Scanning the Horizon** Led by Dist. Prof. Harjinder Singh from the Massey University In collaboration with: - the University of Otago - Lincoln University - AgResearch	$600k over 9 months	Foods with science-backed health benefits have been developed and sold around the world for several decades, so we need a good understanding of what is already on the market and what opportunities there are for new high-value export foods. 'Scanning the Horizon' will take a close look the health-focused foods that are on the market or under development globally, and it will guide the research on food-health relationships towards promising new avenues where there is scope for innovation and the potential for export growth. The 'Bioactive Food Systems' project, scheduled to start in 2016, will address the need to protect the health-promoting compounds (the 'bioactives') in foods during their journey from raw ingredients to finished food products. The Health Programmes will be identifying bioactives that promote optimal health, and the Food Science team will design food ingredients and processes that keep those bioactives in top condition within food products, then release them to the body when those food products are eaten.

CONTESTABLE PROJECTS	INVESTMENT	FOCUS
1. a2 Milk™ for gut comfort Led by Dr Matthew Barnett from AgResearch In collaboration with: - a2 Milk Company - the University of Auckland	$1m over 3 years ($1.5m total value)	There is emerging evidence that milk containing only the A2 form of β-casein aids digestive wellbeing, thereby being suitable for those who perceive themselves to be intolerant to cows' milk. However, the health benefits of consuming A2 milk are scientifically inconclusive. The objective of this proposal is to deliver conclusive scientific evidence for validated benefits of A2 β-casein dairy products on increased gut comfort through prevention of intestinal inflammation. This research, in the form of human clinical studies focusing on small intestinal inflammation and associated symptoms, will enable the NZ industry to capture the most rapidly growing dairy export markets (China and South-East Asia) in which there is a high incidence of perceived dairy intolerance. We aim to demonstrate that differentiated A2 β-casein dairy products can deliver the health benefits of dairy to these consumers, including reluctant dairy avoiders, mindful of problematic dairy digestion. If successful, the research will provide a strong platform for market diversification in both developed and developing markets with the potential to significantly grow demand and revenue for the NZ dairy sector in general.
2. Complex lipids for enhanced metabolic health Led by Dr Emma Bermingham from AgResearch In collaboration with: - Firstlight Foods - the University of Auckland	$1m over 3 years ($1.1m total value)	Consumers are increasingly aware of the risks of metabolic disease and the importance of diet in its prevention. Meat from grass-fed animals contains many bioactive complex lipids that have unexploited potential to improve metabolic health. Cardiovascular disease (CVD), to which metabolic disease can contribute, is a leading cause of death in the US and Asia, both of which are key target markets for NZ ultra-premium meat products. Complex bioactive lipids, when extracted from alternate sources including milk and eggs, are effective in reducing cholesterol absorption. However, the effect of these same complex lipids extracted from a grass-fed bovine source (Wagyu beef) on cholesterol absorption is yet to be validated. This research project aims to provide robust scientific evidence that consuming complex lipids extracted from NZ grass-fed red meat will lead to reduced cholesterol levels in health-conscious consumers. The NZ meat industry is uniquely placed to differentiate its meat products based on these potential health benefits of grass-fed meat. Our aim is to provide scientific evidence of the health benefits of lipids extracted from high-value NZ red meat, that could support a range of products appealing to high-end "Worried Well" North American and Asian consumers who are health-conscious and enjoy consuming meat. Marketed appropriately, beef-based products that reduced cholesterol will be viewed as both "indulgent" and "healthy", and so could benefit from the strong growth in both categories in our target markets.
3. Natural protection of milk Led by Dr Alison Hodgkinson from AgResearch In Collaboration with: - Miraka	$1m over 3 years ($1.7m total value)	The goal of this High Value Nutrition project, in partnership with Miraka, is to unlock the natural health benefits of milk and address the strong desire of parents to minimise allergy in their children. Miraka is an innovative Māori-owned dairy processing and exporting company, who is looking to expand their business by diversifying into higher-value dairy products. They have identified a business opportunity for Growing Up Milk powder that preserves sensitive milk components and has demonstrated ability to reduce the risk of allergy development. The incidence of allergy has markedly increased worldwide in recent decades. Parents are concerned about allergy development in their children and there is a consumer demand for food products that

		reduce this risk. Combined with this is a consumer-pull away from processed foods, following the premise that less processed foods are healthier. Epidemiological studies have shown a clear association between the consumption of raw, unprocessed farm milk and reduced incidence of allergy. However, consumption of raw milk is not safe and to-date no 'safe' milk product is available to fill this market-need. With Miraka, we will develop a Growing Up Milk product that has the natural traits of unprocessed milk and, thereby, delivers added health benefits to toddlers. This value-added New Zealand product will meet demand from parents for natural foods, with validated health claims, that reduce allergy risk in their children. The outcome will be substantially increased economic returns from New Zealand high-value food and beverage exports, in line with the mission of the High-Value Nutrition National Science Challenge.
4. Musseling-up: high-value Greenshell™ musselfoods Led by Dr Matthew Miller from the Cawthron Institute In collaboration with: - Sanford Ltd - Massey University - Christchurch Clinical Studies Trust - Lincoln University - University of Chester	$1m over 3 years ($1.1m total value)	New Zealand's Greenshell™ mussels (GSM) are the heavyweights of our aquaculture export sector, attracting $280m in export earnings each year for their highly desirable taste and plate appeal. While GSM are currently primarily promoted as a whole product, this iconic delicacy has many hidden talents waiting to be realised. The long-term aim of the research is to assist the transition of GSM from a market concentrated on relatively low price "commodity protein" products to a market position based on high-value nutrition and health products. This project will generate scientific evidence of the health benefits of GSM and assist industry to identify and develop optimal GSM-based functional food products that will appeal to the emerging market of wealthy, aging, health conscious consumers – predominantly in China. Proven health claims for GSM-based 'functional foods' will, generate a cumulative $44m in new export earnings for Sanford in the Chinese market by 2025, growing to at least $36m p.a. in 2030, with potentially ten times this when rolled out in other markets, future-proofing New Zealand's important GSM industry.
5. MultiProMo Led by Dr Simon Loveday from Massey University In collaboration with: - Goodman Fielder - AgResearch	$1m over 3 years ($1.2m total value)	As we age we lose muscle mass and function, and many older people find that muscle weakness limits their ability to stay physically mobile and remain independent. Protein and the amino acid leucine are the major nutrients required for muscle maintenance, and in this project we will research how to combine proteins together to improve digestibility and protein uptake for older people. Using this research, we will develop scientifically validated high-protein foods that help to support muscle maintenance in seniors while also meeting their flavour and texture preferences. Many countries, especially in New Zealand's major export markets in East Asia, are faced with ageing populations and skyrocketing healthcare costs. The high-protein muscle maintenance foods that we develop will be targeted towards seniors in China, and will contribute to improving the wellbeing of older Chinese as well as providing substantial export revenue to a New Zealand food manufacturer.
6. Kiwi, fruity and friendly Led by Dr John Monro from Plant & Food Research In collaboration with:	$1m over 3 years ($1.1m total	Glucose intolerance, in the form of prediabetes and diabetes, is affecting hundreds of millions of people in our Asian markets. Over 400 million people in Asia are projected to suffer from diabetes by 2030. As glucose intolerance increases steadily, awareness of the progressive loss of well-being that it causes is leading to an increased demand for foods that:

- Zespri - the University of Otago - AgResearch	value)	1. Produce only a relatively small effect on blood glucose concentrations 2. Reduce the glycaemic impact of other carbohydrate foods 3. Counteract the damage caused by high blood glucose concentrations which leads to the spectrum of serious medical disorders that are typical of long-term untreated diabetes. New Zealand kiwifruit and kiwifruit products have the potential to reduce blood glucose responses and blood glucose effects within a healthy diet by all three of the above mechanisms. Fruit sugars are less glycaemic than starch-based sugars, fruits provide components that physically reduce the rate of sugar absorption, and kiwifruit contain a wide range of phytochemicals that potentially counteract the harm done by elevated blood glucose. Kiwifruit may thus act along multiple dimensions of functionality to bring about a net change in wellness. The research that we propose aims to demonstrate that New Zealand kiwifruit may afford protection against glycaemia and its effects by all three of the above mechanisms – by reducing glycaemic response, by maintaining healthy energy metabolism and by retarding the systemic long-term effects of glycaemia. Armed with a set of relevant and valid biomarkers we will clinically assess the effects of whole kiwifruit and kiwifruit products on a range of biochemical pathways and processes that link high blood glucose concentrations with diminishing wellness. Such research will build a platform for later business-led research on combining and optimising functional attributes through new cultivars, formulations, and food process. The research platform may be extended beyond kiwifruit to other fruit, and it will allow diverse and dispersed attributes of fruits to be drawn together in novel, proprietary, high efficacy and high value fruits and fruit products to meet the health-driven demands and preferences of the Asian market."
7. A good night's sleep Led by Prof Gerald Tannock from the University of Otago In collaboration with: - Victoria University - Drummond Food Science Advisory Ltd	$1m over 3 years ($1m total value)	Food contains complex carbohydrates (dietary fibre) that are not digested by humans. The large bowel (colon), however, is home to a multitude of bacteria that degrade and ferment these carbohydrates. The fermentation products that are produced are organic acids that are absorbed from the bowel and provide energy for the human. The degradation and fermentation of complex carbohydrates takes time and provides a slower, sustained energy harvest compared to the easily digested food components that provide most of human energy requirements. The amount of energy required by the body is less during periods of sleep, but infant waking in the night is commonly believed by parents to be due to hunger. A good night's sleep could be achieved by providing baby food (weaning food) with optimal mixtures of dietary fibres that would enable a sustained energy harvest by bowel bacteria during the night so as to satisfy the body's needs. Optimal mixtures of dietary fibres will be defined through laboratory experiments based on the applicants' knowledge of the bacterial species present in the bowel of children during weaning as well as of new complex polysaccharides. Asia provides excellent opportunities to market new weaning foods: there are 50 million children aged 0-3 years and 40 million aged 3-5 years in China where there is consumer-driven preference for "a good night's sleep" for baby. An eclectic team of scientists, with expertise in microbiology, nutrition, carbohydrate chemistry, food science, sleep, energetics, and food formulation (including associated health claims) has been assembled to carry out the research. The aim is to produce a premium weaning food for evening consumption that will sustain energy harvest in the bowel through the night.

Appendix 2 – Status of current research investments

- not started
- on track
- achieved
- at risk
- not achieved

PRIORITY RESEARCH PROGRAMME	OBJECTIVES	DUE	STATUS
1. GUT HEALTH **Improving Gastrointestinal Function and Comfort** $3.6m over 3.5 years	1. The diagnostic predictability of functional IBS phenotypes determined to allow for design of nutritional intervention studies to establish food effects on relevant biomarkers.	June 2017	
	2. Microbial and host factors identified that provide mechanistic insights and increase the predictability of existing biomarkers of IBS phenotype for use in nutrition intervention studies.	April 2018	
	3. Proof of principle of food interventions in demonstrating clinical predictability of biomarkers in describing food – GIT health relationship established to enable design, development and validating foods to support an ELITE GUT for target consumers.	March 2019	
	4. Insights into factors affecting consumer awareness, generation of activation tools, design and testing of F&B product solutions supported by evidence of GIT function and comfort.	March 2019	
2. IMMUNE HEALTH **Building Immune Defence** $3.5m over 3.5 years	1. The efficacy of F&B solutions to build immune defence against influenza via the restoration of appropriate host-microbiota interactions determined.		
	1.1. The potential to significantly impact immune defence against respiratory tract infection in humans as a result of gut microbiota/influenza vaccine interactions established	October 2018	

	1.2. The ability to predict the magnitude of the human immune response to influenza vaccination established via an integrated systems biology approach	October 2018	
	1.3. The best pre-clinical model for demonstrating beneficial effects for food on immune defence mechanisms through modulation of the gut microbiota defined	March 2019	
	2. Mechanisms of pollution exacerbated respiratory inflammation defined sufficiently to enable the measurement of food-health relationships	March 2019	
	3. Consumer awareness insights and testing of F&B product solutions supported by evidence of building immune defence	March 2019	
3. METABOLIC HEALTH **Peak Nutrition for Metabolic Health** $2.9m over 3.5 years	1. The pre-diabetic Asian phenotype characterised sufficiently to enable identification of targets that will respond to food and beverage solutions	April 2017	
	2. Abdominal obesity and consequent diabetes risk characterised sufficiently to enable identification of targets that will respond to Food and Beverage solutions, and responsiveness to nutritional interventions of relevance to Asian consumer	June 2018	
	3. Causal mechanisms of cardiometabolic risk: pancreatic β-cells/insulin secretion deficiencies identified and responsiveness to nutritional interventions of relevance to Asian consumer defined	July 2018	
	4. Insights into factors affecting consumer awareness of Metabolic Health; identification of tools to promote consumer activation; alongside design and testing of F&B product solution(s) aligned to objectives 1, 2 and 3	March 2019	
4. CONSUMER INSIGHT **Consumer Insight Project 1** $300k over 1 year	1. Insights from extant literature have been merged with existing pre-competitive knowledge of Asian consumers from NZ F&B companies, NZ Trade & Enterprise, Callahan Institute, Ministry for Primary Industry and Asian academic organisations with a focus on food and health, and combined to guide early decisions in the HVN Health Domains.	September 2016	
5. FOOD SCIENCE **Scanning the Horizon** $60ok over 9 months	1. To provide up-to-date, tailored intelligence (in the form of reports and dialogue meetings) on international practice in the development and regulatory approval of Foods for Health and Wellness relevant to the HVN Health Programmes	June 2016	

- not started
- on track
- achieved
- at risk
- not achieved

CONTESTABLE PROJECTS	OBJECTIVES	DUE	STATUS
1. a2 Milk™ for gut comfort $1m over 3 years ($1.5m total value)	1. Differential effects of A1 v A2 milk on selected measures of gut comfort established via pilot human intervention study	March 2017	on track
	2. Cell-based assays completed that provide mechanistic evidence of differential effects of A1 v A2 milk on secretion of cytokines and related miRNA species	March 2017	on track
	3. Differential effects of A1 v A2 milk on selected measures of gut comfort replicated and validated via comprehensive human intervention study	January 2019	not started
2. Complex lipids for enhanced metabolic health $1m over 3 years ($1.1m total value)	1. The lipid profiles of subcutaneous, inter- and intra-muscular fat of NZ Wagyu determined, and compared with other beef sources (e.g. Angus)	January 2017	on track
	2. The extraction method required to obtain complex beef lipids from NZ grass-fed beef determined	December 2017	on track
	3. The effects of complex beef lipids derived from Wagyu on cholesterol absorption determined in a human clinical study	January 2019	not started
3. Natural protection of milk	1. Animal models defined and used to demonstrate potentially protective effects of "specially processed" milk products	January 2018	not started

$1m over 3 years ($1.7m total value)	2. Mechanism of action and potential biomarkers relating to potential protective effects of the specially processed milk determined	January 2019	
	3. Timing and duration of dose (consumption of product) relative to protective effects established	January 2019	
4. Musseling-up: high-value Greenshell™ musselfoods $1m over 3 years ($1.1m total value)	1. Bioactive ingredients in GSM for health claims	June 2018	
	2. Efficacy and biomarkers of inflammation, joint and bone health	December 2018	
	3. Natural to functional GSM foods	January 2019	
	4. Bioavailability and activity in volunteers	October 2018	
5. MultiProMo $1m over 3 years ($1.2m total value)	1. Develop 2 co-processes and 2 product formats (at laboratory scale) involving combinations of food proteins in which co-processing produces equivalent or superior functionality, as compared with separately processed controls.	September 2016	
	2. Produce 1 product format and 2 co-processes (at laboratory scale) for blended proteins for which in vitro simulated digestion of co-processed materials is materially different to the digestion of separately processed controls with the same composition.	March 2017	
	3. Demonstrate that the protein co-processing gives a true ileal digestibility of indispensable amino acids that is equivalent (no statistical difference) or significantly higher than the controls described below: Treatments: / Control: co-processed protein materials 1 & 2 / unprocessed protein mixture product with co-processed proteins 1 & 2 / product with unprocessed protein mixture	June 2017	
	4. Show that a food/beverage made with co-processed dairy and soya proteins produces a higher and more sustained postprandial uptake of branched chain amino acids (BCAA) in humans than a food/beverage of the same format and composition but formulated with proteins that have not been co-processed. Do this for 2 co-processed protein materials in one product format.	September 2018	
	5. Complete a full metabolomic analysis on the serum of volunteers and generate hypotheses to explain metabolic differences.	September 2018	

6. Kiwi, fruity and friendly $1m over 3 years ($1.1m total value)	1. To demonstrate that equi-carbohydrate partial exchange of kiwifruit for staple starch-based components of Asian and European meals will lead to clinically meaningful reduction in postprandial glycaemic and insulin responses and beneficial changes in plasma hormones and factors involved in glucose homeostasis and energy metabolism.	December 2016	
	2. To establish that regular kiwifruit consumption is either neutral or positive in healthy human adults with respect to effects on intermediary metabolism that may predispose to diabetes, despite increased fructose intakes associated with ingestion of fruit.	December 2017	
	3. To demonstrate that the combination of properties and bioactives that constitute whole kiwifruit has the capacity to counteract important human physiological processes, such as inflammation and oxidative damage, that together with metabolic dysregulation lead to medical complications typical of long term untreated diabetes	December 2018	
7. A good night's sleep $1m over 3 years ($1m total value)	1. Preparation of novel combinations of dietary fibres. Plant polysaccharides varying in chemical structure (chosen to support prolonged fermentation and energy release by infant gut bacteria) for use in bacteriological experiments will be extracted, purified, and chemically characterized, in sufficient quantity for the experiments.	December 2017	
	2. Bacterial species commonly present (>90% of babies) in the faeces of Asian weanlings 6 months of age, and which can grow on the selected plant polysaccharides (Objective 1) will be chosen for microcosm experiments.	December 2016	
	3. The optimal melange of dietary fibres that will provide quality energy harvest by bacterial fermentation will be determined using microcosms. A quality energy harvest will be judged in terms of qualitative and quantitative aspects of SCFA production sufficient to justify inclusion in a clinical study to demonstrate meaningful improvement in the sleep patterns (ie length) of infants when compared with current diets.	June 2018	
	4. The quality of the bacterial fermentations will be compared, particularly by the production of acetate and propionate, since these two SCFA provide sources of energy extra-intestinally At least one fermentation pattern will demonstrate sufficient production of sources of extra-intestinal energy to justify inclusion in a clinical study to demonstrate meaningful improvement in the sleep patterns (ie length) of infants when compared with current diets.	June 2018	
	5. Associations between SCFA production of the microbiota and infant sleep of NZ infants in current aligned research will be determined. This information will establish SCFA profiles that likely to be effective in influencing sleep patterns of infants.	December 2018	
	6. The postdoctoral fellow will integrate laboratory results with prospective food formulation and large scale dietary fibre production so that human trials can proceed in Phase II. This will define prospective test foods that are capable of extending infant sleep periods sufficiently to provide a meaningful benefit to them and their parents.	December 2018	

Appendix 3 – Summary of KPIs

Performance Area	Measure	Indicative Targets (Nice to have)	Targets (Must do)
1. Delivery of the Challenge Objective	**1.1 Industry Validation of Research Plans** Proportion of priority research investments (programmes and projects) made with good evidence of target consumer's need and demand in export markets coupled with clear NZ F&B businesses endorsement. (With a submeasure relating to engagement with Māori-owned businesses)	Nil	> 50% (score) at initiation (assessed both individually and collectively) > 100% at the 24 month review
	1.2 Investment Performance to Plan % HVN funded research project and programme research objective end points (results) met on time to specification	Nil	> 60% as budgeted > 80% as reforecast
	1.3. **Biomarkers** Number of "biomarkers" responsive to nutrition that address consumer health targets identified that underpin applications submitted to FSANZ under standard 1.2.7 or self-substantiated general level claims notified with supporting scientific evidence of the food health relationship	> 2 in total from aligned and related research by 2016 > 4 in total from aligned and related research by 2018 > 4 in total from aligned and related research by 2020 > 6 in total from aligned and related research by 2023	>3 in total from funded research with >1 in each priority health target area by 2018 >6 in total from funded research with >3 in each priority health target area by 2020 >15 in total from funded research with >5 in each priority health target area by 2023
	1.4 Businesses using HVN Capabilities Number of F&B businesses using "HVN capabilities" to develop and or support products as part of the process of validation of health benefits for target consumers. (With a submeasure relating to engagement with Maori-owned businesses)	>5 in total from aligned and related research by 2016 >5 in total from aligned and related research by 2018 >5 in total from aligned and related research by 2020 >5 in total from aligned and related research by 2023	>10 in total from HVN funded research with >2 per priority research programme by 2018 >16 in total from HVN funded research with >4 per priority research programme by 2020 >20 in total from aligned and related research by 2023
	1.5 Products in Development Number of discrete F&B products in development with significant export potential supported by "evidence dossiers" involving HVN research demonstrating health benefits for target consumers. (With a submeasure relating to products involving Maori-owned businesses)	>3 in total from aligned or related research by 2016 with 5 year sales projections >$50M >3 in total from aligned or related research by 2018 with 5 year sales projections >$50M >5 in total from aligned or related research by 2020 with 5 year sales projections >$50M >5 in total from aligned or related research by 2022 with 5 year sales projections of >$50M each >5 in total from aligned or related research by 2024 with 5 year sales projections of >$50M each	>3 in total from funded research (with >1 per priority Health Target Area) by 2018 with 5 year sales projections of >$50M each >9 in total (with >3 per priority Health Target Area and >2 per priority research programme by 2020) by 2020 with 5 year sales projections of >$50M each >10 in total by 2022 with 5 year sales projections of >$50M each >10 in total by 2024 with 5 year sales projections of >$50M each
	1.6 Industry Co-Investment Value of R&D investment by F&B businesses in "HVN capabilities" to support development and marketing of F&B	>$1M from aligned or related research in CY2016 > $2M from aligned or related research in CY2018. > $2M from aligned or related research in CY2020	>$1M in aggregate from funded research by year end CY2018 >$2M from funded research in CY2020

	products with health benefits. (With a submeasure relating to investment by Maori-owned businesses)	> $2M from aligned or related research in CY2023	>$5M from funded research in CY2023
	1.7 Evidence Dossiers Number of "evidence dossiers" (derived from HVN research or teams) submitted to FSANZ (or notified by businesses under the FSANZ model) in support of approved food health claims	> 2 from aligned or related research by 2016 > 3 from aligned or related research by 2018. > 3 from aligned or related research by 2020 > 4 from aligned or related research by 2022 > 6 from aligned or related research by 2024	> 2 in total from funded research by 2018. > 3 in total (including >1 per priority health research programme) from funded research by 2020 > 6 in total (with >2 per priority Health Target Area) from funded research by 2022 > 10 in total from funded research by 2024
	1.8 Revenues Value of export revenues from discrete food and beverage products supported by evidence based on "HVN research" demonstrating health benefits for target consumers. (With a submeasure relating to revenues from Māori-owned businesses)	> $10M additional F&B export revenues from aligned and related research in CY2016 > $150M additional F&B export revenues from aligned and related research in CY2019 > $300M additional F&B export revenues from aligned and related research in CY2022 > $500M additional F&B export revenues from aligned and related research in CY2024 > $650M additional F&B export revenues from aligned and related research in CY2025	> $10M additional F&B export revenues from funded research in CY2019 > $150M additional F&B export revenues from funded research in CY2022 > $250M additional F&B export revenues from funded research in CY2024 > $350M additional F&B export revenues from funded research in CY2025 > $1B pa additional F&B export revenues from funded, aligned and related research by CY2025
	1.9 International reputation New Zealand's international reputation as a food producer of high quality and scientifically validated food health benefits is enhanced	Nil	Three yearly survey in 2016/2019/2022 and 2025 (of target international consumers, regulators , importers and other relevant stakeholders) showing positive ongoing increases in "positive" reputation
2. Science Quality	**2.1 Citation scores** Mean citation scores for journals in which the Challenge has published	Nil	Nil
	2.2 Citation index Field weighted citation index of Challenge publications	Nil	Nil
	2.3 Publications top quartile journals Number of publications in journals within the top quartile (field-weighted) of peer reviewed scientific per $5M invested	Nil initially	Nil initially
	2.4 International science reputation New Zealand's international reputation in the science of food health relationships is enhanced	Nil	Nil
3. Best Research Team Collaboration	**3.1 Collaborative publications** % Publications by collaboration type (ie with co-authors from multiple research organisations and/or with international co-authors) on a 12 month rolling average	Nil	>80% publications with co-authors from more than one NZ based research organisation >60% publications with co-authors from more than two NZ based research organisations > 15% publications with international co-

			authors
	3.2 Research team effectiveness Effectiveness of research team re science leadership, skills mix, etc.	Nil initially	Nil initially
4. Stakeholder Engagement	**4.1 Stakeholder satisfaction re influence** Satisfaction among stakeholders with research priority setting	Nil initially	Nil initially
	4.2 Stakeholder satisfaction knowledge exchange Satisfaction among stakeholders with knowledge exchange and technology development	Nil initially	Nil initially
5. Maori Involvement and Mātauranga	**5.1 Maori stakeholders satisfaction re influence, engagement and value** Satisfaction among Maori stakeholders with their influence on, engagement with, and value received from the Challenge	Nil initially	Nil initially
	5.2 Investment in VM initiatives $ value of investment by HVN in research and related activities that 1) specifically target Maori needs and aspirations and 2) employ Mātauranga Maori	Nil	Re 1) >$2M in aggregate of contestable funds in the first funding period (ie by 30 June 2019) >$2M in aggregate of contestable funds in the second RfP (ie from 2019 to 2021) >$2M in aggregate of contestable funds in the third RfP (ie from 2021 to 2024) Re 2) Nil
6. Effective Governance and Management	**6.1 Quality of Governance** Qualitative assessment of governance processes	Nil	Satisfactory or better in all dimensions assessed
7. Public Participation	**7.1 Public Awareness** Index of public attitudinal and behavioural engagement in science	Nil	Nil