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STUMP TO PUMP PRIMARY GROWTH PARTNERSHIP PROGRAMME

Evaluation Report

Comprehensive summary report on evaluation of progress toward outcomes

15 January 2015

CONTENTS

APPENDICES

This report was prepared for the Ministry for Primary Industries by MartinJenkins (Martin, Jenkins & Associates Limited).

EXECUTIVE SUMMARY

Introduction

In October 2014 MartinJenkins was contracted as independent evaluators of the Stump to Pump Primary Growth Partnership (PGP) programme for the Ministry for Primary Industries (MPI). The purpose of the evaluation was to examine progress towards the programme's intended outcomes and key barriers and enablers to achieving outcomes, and to identify lessons learned. Interviews were conducted with nine key stakeholders, and programme documentation was reviewed. This report documents the evaluation findings.

Background

In 2013, the Ministry for Primary Industries (MPI) approved co-investment of up to $6.7 million in Stump to Pump as a Primary Growth Partnership (PGP) programme (total budget $13.5 million).

Norske Skog and Z Energy jointly led the Stump to Pump programme which aimed to validate the technical and commercial feasibility for the conversion of radiata pine residuals into liquid fuels connecting directly from the forest floor to the end consumer. The two industry co-investors offered a cross-sector partnership with the potential to create an end-to-end value chain for large-scale biofuel production and distribution.

The Stump to Pump programme, as defined in the signed PGP agreement, was contracted to assess the feasibility of converting radiata pine into biofuels as the key outcome.

The expected outcome was that the feasibility study would provide sufficient information to enable decisions to be made on the viability of proceeding to the construction of a modular test plant for the conversion of radiata pine residues into biofuels. Expected outputs were:

Economic

- confirm the capital and operating costs of a test plant
- costs of forest residual recovery and returns to forestry sector
- economics of path to market for biofuels / biochemicals

Sustainability

- identify environmental impacts and mitigation strategy to limit environmental impacts
- identify the impact on the forest industry to support biofuels industry based around forestry residues

Capability

- validate the technologies and provide solutions to mitigate risks associated with conversion of biomass to liquid fuels
- acceptance from market for biofuel end products.

Key findings

Outcomes achieved

The study achieved its intended outcome by determining that it was technically feasible to convert radiata pine residues to liquid biofuel feedstocks suitable for the New Zealand market. However, the current global economic and energy outlook make the commercial viability of Stump to Pump marginal and too high risk at present.

The programme has, at the same time, resulted in some ongoing benefits for the forestry sector. Stump to Pump confirmed the availability and quality of New Zealand-wide woody biomass suitable for use in conversion technologies, including the production of biofuels. The feasibility study was also comprehensive in its assessment of both the technical feasibility and the commercial challenges. The findings of Stump to Pump are likely to save the forestry sector time and money by encouraging a redirection of forestry industry research and development efforts away from examining the technical question of the feasibility of biofuels towards other potential value-add wood processing ventures.

The programme was implemented effectively and benefitted from strong governance structures and continuity of key personnel. The feasibility study undertaken was comprehensive and all contract outputs were delivered within timeframes and significantly under budget.

Enablers

Key enablers of the programme's successful implementation included:

- prior research and analysis undertaken by project partners – these yielded promising results that were worthy of more detailed investigation
- the conditions – these were right for co-investment by the forestry and energy sectors in New Zealand
- the importance of establishing partnerships across the forestry and energy sector value chain – these were critical to the outcome of the project and level of confidence in the findings
- strong governance and project management - the feasibility study was completed in the agreed timeframe and significantly under budget.

Barriers

The main challenge to achieving the programme's intended outcomes within the anticipated timeframes was a change in the global economic outlook for fuel. This made Stump to Pump project economics more challenging for prospective commercial investors. Key changes were:

- changes in the global energy market and a decline in oil prices, which are likely to be sustained
- competition and rapid changes in transport energy alternatives
- less appetite for, and increased challenges facing, commercial-scale renewable fuel projects internationally.

The programme also required an unexpected variation to the Stump to Pump PGP Agreement to expand the techno-economic evaluation component of the programme.

Next steps

Norske Skog and Z Energy have built a partnership and are committed to continue to work on the biofuel modification and optimisation to produce petrol and diesel that meet New Zealand fuel quality specifications. A product acceptance timeline and plan have been developed for product testing and fuel certification requirements for the New Zealand market. This is expected to take a minimum of 2-3 years to complete.

The industry partners will also continue to monitor the overall economic environment and global biofuels market development and explore ways to accelerate the pathway forward for Stump to Pump.

Value of investment

The programme was a worthwhile investment. Industry co-investors were clear throughout the programme that the level of commercial risk was too high for a single organisation to bear outright and that the programme would not have proceeded without government investment.

While the risks were high, the potential benefits were also high. Had the study confirmed the economic and technical viability of the proposed technology, the potential programme benefits were significant for New Zealand. By 2030, estimated total programme benefits were over $1 billion GDP per annum.

On balance, the significance of the benefits to New Zealand, including the potential benefits to the forestry sector, coupled with promising results for prior testing of the conversion technology, outweighed the inherent risks for MPI of investment in a feasibility study.

Lessons learned

Key lessons, some of which have already been addressed by MPI, include these points.

- Where future PGP applications involve a high risk feasibility study and involve sectors which fall outside of MPI's areas of expertise, external input from technical or commercial specialists may be warranted.
- Strong governance and project management: This programme demonstrated, by providing a good example, that the calibre and seniority and governance experience of individuals on the PGP Steering Group and the project leadership are critical to a programme's success.
- Clearer guidance for industry partners on PGP administrative requirements may reduce the administrative burden - in particular, more MPI support for industry investors during the business case development process would have been beneficial for the industry partners.

Fit of feasibility studies with PGP fund

While each study must be assessed on its own merits, feasibility studies like Stump to Pump are a strong fit for the PGP programme. Key reasons include:

- it was a high risk programme, due to the unproven technology at a commercial scale, that was unlikely to be undertaken by any one part of industry without government investment
- to be successful, the feasibility of all elements of the value chain needed to be understood and tested. Creating a new path to market required expertise from the forestry and energy sectors
- if found to be feasible, the economic benefits for a struggling forestry sector and the wider economy were significant.

BACKGROUND

Primary Growth Partnership (PGP)

The Primary Growth Partnership (PGP) was established as a 2009 Budget initiative by the then Ministry of Agriculture and Forestry. PGP programmes are intended to boost the economic growth and sustainability of New Zealand's primary industries by matching private sector partners in market-led investments into innovative and knowledge creating activities.

Stump to Pump PGP programme

Context for Stump to Pump PGP investment

There is a strong drive within New Zealand's forestry sector to identify new market pathways to extract more value from the country's forests. The New Zealand forestry sector currently has limited growth opportunities through traditional wood processing options due to narrow and shrinking export markets, international competition and a saturated domestic construction sector.

The Stump to Pump PGP programme sought to confirm the technical and commercial feasibility of converting radiata pine residues into liquid fuel using an innovative technology. This was strongly aligned to the Wood Council of New Zealand's (Woodco) Strategic Action Plan for the New Zealand forest and wood processing industry to increase the volume of wood processed in New Zealand to add value to forest product exports[1].

Stump to Pump PGP programme structure

The primary objective of the Stump to Pump PGP programme was to determine the technical feasibility and commercial viability of creating a biofuels business in New Zealand from radiata pine residues. The vision behind the Stump to Pump PGP programme was to:

> *contribute to the rejuvenation of the New Zealand forest and wood processing industry by generating a new high value market pathway for woody biomass residues.*

In 2012, Norske Skog and Z Energy applied for PGP funding over four years for two projects.

- Project 1 aimed to:
  - validate the processes for producing and refining bio-crude oil, including the technology to convert radiata pine to bio-crude and investigate the availability, economic viability and sustainability of feedstocks
  - design a modular test plan to enable easy scalability to commercial production.
- Project 2 was to construct a modular test plant.

[1] SCION, February 2013. WoodScape Study, http://woodco.org.nz/images/stories/pdfs/woodscape/woodscapesummaryreportfinal1_web.pdf

The initial application was partially successful. Co-investors were invited to develop a full business case for Project 1.

A decision on the eligibility of Project 2 for PGP funding was deferred and was only to be considered if the Stump to Pump business concept was found to be viable following completion of Project 1.

The industry co-investors both had a strategic commitment to the production of biofuels in New Zealand. They offered a cross-sector partnership with the potential to create an end-to-end value chain for large-scale biofuels production from radiata pine residues.

- Norske Skog Tasman is a pulp and paper manufacturer that brought wood processing and engineering expertise to the programme.
- Z Energy is a fuel distributor and retailer. They brought expertise and channels to establish a market pathway for the biofuel.

The programme was contracted in July 2013 with an end date for the programme of 30 September 2014. PGP funding of up to $6,748,000 over the life of the programme was approved, with total project costs for the Stump to Pump programme projected to be $13,496,000.

The intended outcome of this programme was that:

- the feasibility study would provide sufficient information to enable decisions to be made around the viability of proceeding to the construction of a modular test plant for the conversion of radiata pine residues into biofuels.

This included assessing the following elements of the path to market:

Economic

- confirm the capital and operating costs of a test plant
- costs of forest residual recovery and returns to forestry sector
- economics of path to market for biofuels / biochemicals

Sustainability

- identify environmental impacts and mitigation strategy to limit environmental impacts
- identify the impact on the forest industry to support biofuels industry based around forestry residues

Capability

- validate the technologies and provide solutions to mitigate risks associated with conversion of biomass to liquid fuels
- acceptance from market for biofuel end products.

The programme was contracted to deliver on a number of specific and measurable outputs to support the delivery of outcomes. These outputs were achieved with the exception of the Reference testing and biofuels trials which will continue beyond the scope of the PGP funded programme. The contracted outputs were:

- Completion of the validation of technologies.

- Scale up issues identified.
- Test plant design completed. This included the following four work-streams:
    1 Solutions for collection and processing of feedstocks identified.
    2 Solutions for biomass conversion to biofuel identified.
    3 Solutions for biofuel logistics and storage identified.
    4 Test plant equipment requirements identified.
- Reference testing and optimising trials on biofuel completed.
- Waste stream and by-product processing assessed.
- Validation of biofuel processing and downstream products completed.
- Final Report.

The PGP funded Stump to Pump feasibility study was substantively completed by August 2014 and the final report issued on 30 September 2014.

EVALUATION APPROACH

MPI contracted MartinJenkins in October 2014 to independently evaluate the Stump to Pump PGP programme, specifically to examine:

- progress towards delivering the programme's intended outcomes, any unintended outcomes, and the programme's overall value (was the programme worth it?)
- key barriers or enablers to achieving outcomes
- lessons learned, to inform the management and development of PGP.

Evaluation data

The data used for assessments of the effectiveness of programme implementation and the programme's progress towards (short- and medium-term) outcomes is described below.

Document review

Key documents were reviewed to assess the programme's implementation and progress towards (short- and medium-term) outcomes. The documentation included the business case, PGP Agreements (contract), outcome logic and the final report.

Stakeholder interviews

Interviews were conducted with nine key stakeholders. This included a mix of representatives from the industry co-investors, a programme partner, MPI and Treasury officials and the IAP. The questions covered the following key themes: programme design; implementation and outputs; outcomes achieved; lessons learned; and value of the investment and future investment.

OUTCOMES ACHIEVED

The programme successfully delivered its intended outcome and produced some lasting benefits for the forestry sector

The primary objective of the programme was to determine the technical and commercial feasibility of converting New Zealand forestry residues to liquid biofuels. As a feasibility study, a successful outcome was sufficient analysis being undertaken for stakeholders to be confident of the programme conclusions, and if feasible, being well-positioned to progress to the next phase.

The programme confirmed the technical feasibility of converting radiata pine residues to biofuel and biodiesel but identified a number of both technical and commercial barriers to continuing with the detailed design and construction of a modular test plant as originally envisaged.

To reach this conclusion, the programme undertook a systematic assessment of each component of the path to market. In particular, the programme:

- identified the quantity, quality and ease of access to feedstocks throughout New Zealand
- reviewed and assessed a wide range of current biofuel conversion technologies worldwide for their fit to the New Zealand market and identified a preferred technology
- identified risks and mitigation strategies for commercialisation
- determined the economic and market conditions under which this business venture would be commercially viable.

The programme determined that a further minimum 2-3 years were required to improve the fuel properties and progress fuel certification and testing requirements necessary to meet New Zealand fuel equivalency. While further work is required, it is believed that these products will likely be able to meet New Zealand fuel specifications. The final report concluded that

> *Whilst a technically feasible path for New Zealand has been identified to convert forestry residues to liquid fuels, to achieve commercial viability and a path to market, the study team has determined that additional time will be required…*[2]

Both industry co-investors are committed to continuing to work together on refining the technology solution identified through the PGP programme.

Most critically, however, the report also identified a number of barriers to the commercial viability of the programme at this time. During the life of the programme, the economic outlook changed, making

[2] Norske Skog Tasman / Z Energy Stump to Pump Project. Final Report. 30 September 2014

the Stump to Pump project economics more challenging for prospective commercial investors. This included:

- changes in the global energy outlook and a decline in oil prices
- competition and rapid changes in transport energy alternatives
- changes in appetite for and new challenges facing renewable fuel projects internationally.

Forestry sector benefits

The programme resulted in some lasting benefits for the forestry sector despite the commercial and economic challenges for Stump to Pump's continuation at this time.

The production of biofuel from biomaterials is not a new idea. There has been forestry sector interest in producing biofuels from radiata pine residues for some time. The use of woody biomass for the production of biofuels has been investigated a number of times but to date the production cost of liquid transport biofuels from wood has been substantially higher than fossil fuels, undermining the economic feasibility.

While renewable transport fuels from forest residues will take longer to realise, the programme confirmed the opportunity to commercialise opportunities from New Zealand's wood resources. The Stump to Pump PGP programme commissioned studies to confirm the availability of suitable biomass in the Central North Island to support a commercial plant at Kawerau and subsequently assess whether there was sufficient feedstocks available for the planned expansion to eight biofuel plants in New Zealand. Scion undertook analysis which shows an estimated 3.9 million m^3 of available residues within New Zealand in 2014 which is expected to increase to 5.8 million m^3 in 2025. As the Stump to Pump final report concluded:

> *Industry now has a comprehensive understanding of the feedstock availability and characteristics, including the nature and location of the resource, costs and methods for recover and delivery to processing sites and chemical composition. This will not only help Stump to Pump progress to the next stage but also facilitate the commercialisation of other residue based product opportunities.*

The Stump to Pump programme findings are likely to save effort and financial investment by other forestry sector stakeholders exploring liquid biofuel options. The study concretised the path to market and identified challenges specific to the New Zealand fuel market.

This study has resulted in increased industry understanding of the:

- quality of bio-crude required to suit the operating parameters of the New Zealand oil refinery
- biogasoline and biodiesel quality required to meet fuel specifications and be compatible with the New Zealand petrol and diesel distribution network
- current state of conversion technologies for biofuel production from woody mass and identification of the most technically and economically viable technologies within the New Zealand context
- economic and market conditions under which the production of biofuel from radiata pine residues could become commercially viable.

As a result, the forestry sector is now likely to focus on exploring other renewable energy and wood processing options.

Enablers and barriers

Enablers

There were a number of key success factors which led to the successful implementation and achievement of the Stump to Pump PGP programme's intended outcome.

- Prior investigation and analysis of variables indicated biofuel production from radiata pine residues was a feasible option and conditions were right for co-investment by the forestry and energy sectors in New Zealand.
    - The Wood Council of New Zealand (Woodco) had commissioned a study to identify pathways forward for the sector to realise its strategy of increasing the volume of wood processing in New Zealand; doubling exports to $12 billion by 2022. That study identified biofuels and biochemicals as one of two promising areas for new wood processing technologies. Biofuel production had been of interest to the forestry sector for many years.
    - Norske Skog's strategic direction is to invest in new technologies and diversify their market offering, towards bio products and energy opportunities.
    - Z Energy has an objective to produce and sell renewable fuels in the New Zealand fuel retail market and is committed to reducing New Zealand's reliance on fossil fuels.
    - New Zealand Trade and Enterprise's (NZTE) Strategic Initiative Fund had already invested $250,000 in a concept stage study which had determined it was potentially feasible to profitably produce bio-crude from radiata biomass.
- Co-investment and partnerships across the forestry and energy sectors were critical to the outcome of the project.
    - To be certain of the commercial viability, an assessment of all elements of the path to market was necessary. Within the Stump to Pump PGP programme this ranged from assessing the supply (quantity, quality and ease of access) to radiata pine feedstocks nationally through to understanding the product's compatibility with fuel supplier requirements. Previous work undertaken by Z Energy on consumer demand for biofuels also informed the commercial viability assessments.
    - The programme involved multiple other partners across the value chain.
- Strong governance and project management.
    - Stump to Pump had a clear governance and management structure and senior representatives of both Norske Skog and Z Energy were engaged in the programme. There was also continuity of key personnel throughout the programme.
    - The capability and experience of the Programme Director to manage the technical work streams and keep the project on track and within budget was seen as a key strength of Stump to Pump.
    - Risks were identified early and worked through collaboratively between industry co-investors and MPI.

Barriers

External factors

There were a number of significant barriers to the immediate continuation of the Stump to Pump programme beyond the feasibility study. The following factors in the operating environment changed or became more apparent risks during the life of the programme:

Global energy market

The oil industry has increased their use of fracking and other ‘tight oil’ recovery processes to recover more mineral based oil. Large shale oil finds and new processing technologies are likely to lead to increasing available supplies in the near to medium term.

As a result, oil prices are expected to remain lower. This may continue for a prolonged period of time, barring geopolitical events.

In the longer term, upside pressure on oil prices will emerge but this may be offset by slowing growth in oil demand.

New Zealand exchange rate

The New Zealand exchange rate has traditionally been volatile and is currently high. While a high exchange rate may have a favourable impact on capex for the construction of the test plant, it has significant negative impact on the overall project economics.

Lignocellulosic renewable fuels market

The immaturity and rapid change in the biofuels market was also a risk factor. There are only a few commercial-scale plants for the production of biofuels from wood in the world. These plants are all very recent and none are operating without government subsidisation. Most of these plants have encountered significant scale-up challenges in order to meet operational and financial expectations of investors.

The preferred technology for Stump to Pump is still unproven at scale. While laboratory results look promising, there are inherent risks in being the first to build a commercial scale plant. This included a risk of over-engineering the design of the plant.

While these factors were outside of the control of the Stump to Pump PGP programme, they had a significant impact on the commercial feasibility of the end goal.

Unanticipated challenges for the programme

The design of the Stump to Pump PGP programme anticipated that in-depth product testing would be required to validate any promising technology as feasible and a preferred option for the New Zealand market.

Initial work in the programme identified that there would be compatibility challenges for some technologies with the New Zealand fuel supply chain. This required a variation to the Stump to Pump PGP Agreement to expand the techno-economic evaluation part of the programme.

The techno-economic evaluation found that a range of different technology could fit New Zealand's needs. The selection of the preferred technology for the feasibility study was based upon the technical robustness, technical risks and the quality of the hydrocarbons produced. This had a number of flow on implications for the programme, including the need for more in-depth testing and assurance of the biofuel to:

- ensure it meets New Zealand fuel standards
- ensure the stability and consistent quality of the fuel produced
- confirm it is compatible with the mineral petrol and diesel distribution network, and
- test and confirm the biofuel had no negative impacts on engines, fuel systems or the environment.

The time required to investigate these factors, coupled with the changed economic and energy market outlook led to the decision of the industry co-investors to end the Stump to Pump PGP programme as originally planned on 30 September 2014 and continue to work on the commercialisation pathway independently of PGP. At this stage the industry partners are not in a position to make a decision on progressing with the detailed design and construction of a biofuel test plant until the additional work has been completed.

Next steps

Industry co-investor activities post PGP programme

Norske Skog and Z Energy have built a partnership and are committed to continue to work on the biofuel modification and optimisation to produce petrol and diesel to the New Zealand fuel quality specifications.

The next steps identified by the industry stakeholders are to:

- continue to investigate fuel quality and product assurance for the most promising technology
  - a product acceptance timeline and plan have been developed for product testing and fuel certification requirements for the New Zealand market
- await commercial progress towards construction of the first pioneer plant offshore - this plant will have the capacity to test technology on a small enough scale but produce sufficient quantity of fuel to comply with regulatory processes for fuel acceptance
- complete regulatory process for fuel testing and certification
- continue to monitor the overall economic environment and global biofuels market development
- continue to engage with government on the strategic issues for Stump to Pump and explore ways to accelerate the pathway forward for Stump to Pump.

Value of investment

Overall, stakeholders considered the Stump to Pump PGP programme was a worthwhile investment,

If the study had confirmed the economic and technical viability of the proposed technology, the potential programme benefits were significant for New Zealand. The total programme benefits, based on the economic benefits from eight commercial production facilities being commissioned by 2030, were calculated as being in excess of $1 billion GDP per annum by 2030, and, based on fuel substitution, an improvement in the balance of trade of $500 million per annum by 2030. This included an estimated $100 million in wages and salaries at the processing plants.

For forest growers and wood processors, direct net economic benefit was estimated to be $80 million per annum by 2030 if eight commercial plants were in operation. MPI officials observed that the direct benefits to forestry growers and processors were probably underestimated due to the likely flow-on effects of a resilient forestry sector.

Industry co-investors were clear throughout the programme that the level of risk was too high for a single organisation to bear outright and that the programme would not have proceeded without government investment.

The decision to invest in Stump to Pump was worthwhile. Although the feasibility study did not continue on to the detailed design and build of a modular test plant, work is ongoing and the technical feasibility of producing biofuel from radiata pine residues for the New Zealand fuel market was proven. Other benefits which accrued from the investment include:

- The creation of a potential new value chain and the development of partnerships in unrelated industries. Co-investors observed that the programme had strengthened their relationships with each other and with government. This had value beyond the duration of the project.
- Investment in the Stump to Pump PGP programme has benefited the forestry sector by encouraging a redirection of research and development efforts away from examining the technical question of the feasibility of biofuel towards other potential value add wood processing ventures.

LESSONS LEARNED

The Stump to Pump programme offers a number of lessons for MPI's management of PGP.

Lessons for MPI management of PGP

Investment decision making for high risk programmes

Where programmes are defined as very high risk (eg they propose to develop a new industry in New Zealand, or intend to implement an unknown technology) a high level of scrutiny is required to develop a preliminary view of the risk and potential for success. However, this needs to be balanced against the reality that a feasibility study is inherently risky and it is to be expected that conducting a feasibility study may lead to unanticipated outcomes.

For Stump to Pump, there was a significant level of pre-feasibility work that had already been undertaken. The PGP Investment Advisory Panel also strongly scrutinised the proposed business case, which led to improvements.

However, by way of example, further independent review of the business case by a technical or commercial specialist may have provided MPI with greater insight to potential programme risks.

Where future PGP programmes involve sectors that fall outside of MPI's areas of expertise, seeking external input from elsewhere in government or from a commercial specialist may be warranted.

Importance of strong governance and project management

There is an opportunity to draw on project management lessons from Stump to Pump, if appropriate, for other PGP programmes. In particular, strengths of the Stump to Pump PGP programme were:

- early face-to-face interactions between project partners and stakeholders
- development of a shared communications strategy before the contract is finalised
- senior representatives and continuity of individuals on the Steering Group
- clear deliverables, milestones and go / no-go decision points set out in the business case - this facilitated the contracting process.

Clearer guidance for industry on PGP administrative requirements

While PGP practices have progressed since Stump to Pump was commissioned and undertaken, clear guidelines for reporting requirements would have benefited the industry partners.

- It was observed by an industry stakeholder that PGP funding came with the highest administrative burden relative to the funding envelope that they had ever encountered.
- For some of the industry co-investors, clear instructions would have been preferred to the more flexible approach adopted initially.

Support for industry during business case development process could also be improved.

- The business case requirements were broader than a typical business case for a commercial project and the industry co-investors struggled with this part of the process; without this support there is a risk of worthwhile initiatives dropping out of the PGP pipeline prematurely.

Alignment of feasibility studies with PGP

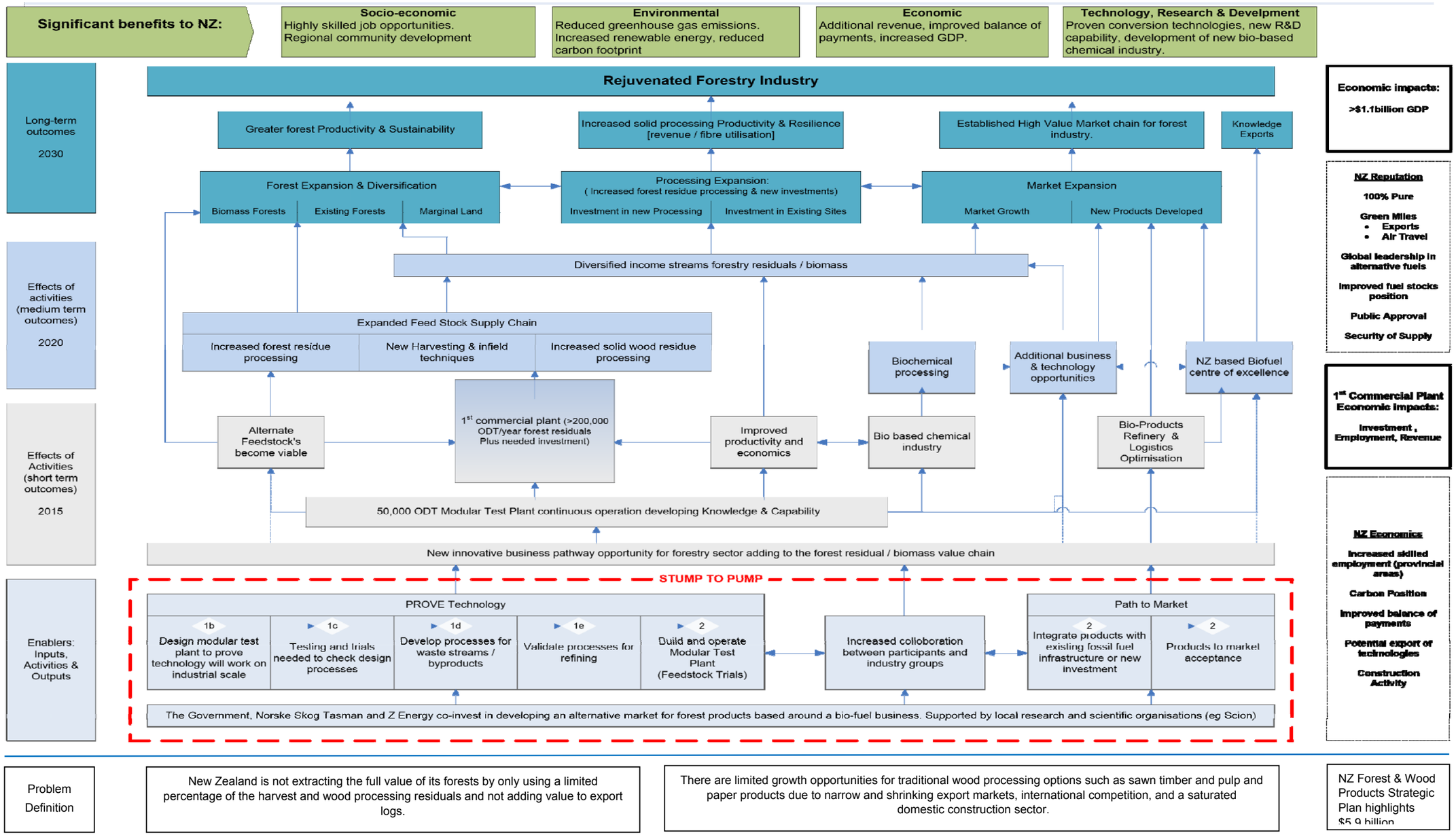
The evaluation concluded that Stump to Pump was a strong fit with PGP. Stump to Pump was a high risk programme in terms of the uncertain likelihood that the business concept would be proven to be technically and commercially viable. Stump to Pump was investigating the feasibility of a new industry based on untested technology that was not operational on a commercial scale anywhere in the world.

This type of feasibility study is a strong fit for the PGP. Criteria that might be used to assess the fit of future feasibility studies might include:

- initiatives beyond business as usual for a primary sector or industry
- unproven technology at commercial scale viability
- projects where there is sufficient interest from more than one sector, or partners across a primary sector value chain support co-investment
- high potential economic benefits to New Zealand.

For MPI and the IAP, the significance of the potential economic benefits to New Zealand and the development of a new revenue stream for the forestry sector if the programme was successful were the primary reasons for choosing to invest in this programme. The level of risk involved for industry was also identified as part of the case for government investment.

APPENDIX 1: OUTCOME LOGIC FOR STUMP TO PUMP PROGRAMME



Problem Definition	New Zealand is not extracting the full value of its forests by only using a limited percentage of the harvest and wood processing residuals and not adding value to export logs.	There are limited growth opportunities for traditional wood processing options such as sawn timber and pulp and paper products due to narrow and shrinking export markets, international competition, and a saturated domestic construction sector.

NZ Forest & Wood Products Strategic Plan highlights $5.9 billion