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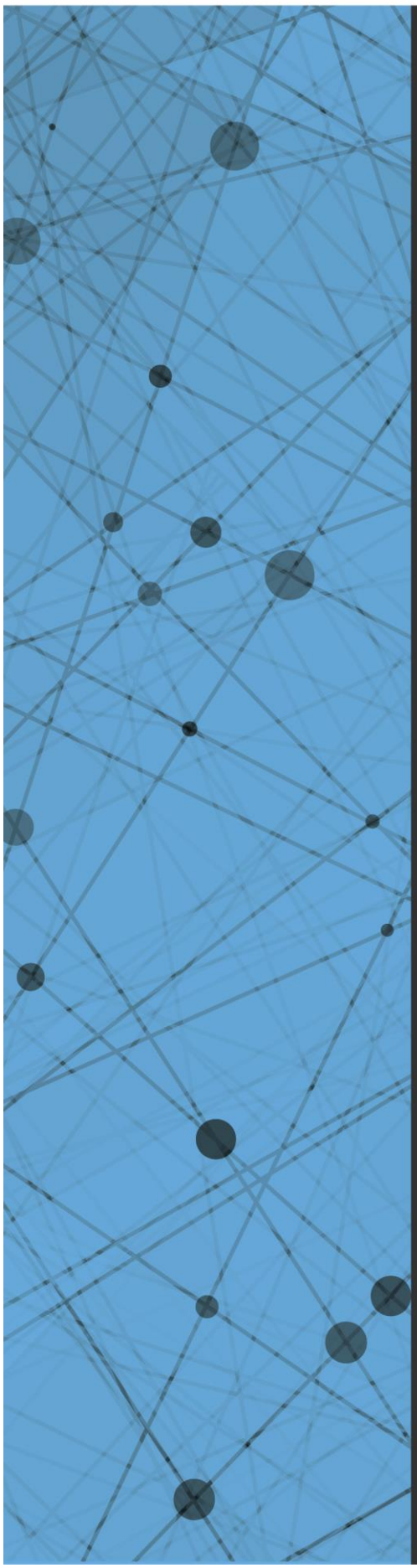

Facilitating Carbon Offsets from Native Forests

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Disclaimer

All opinions are those of the authors and we are also responsible for any errors or omissions.

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Abstract

This note aims to help firms looking to offset their Greenhouse Gas (GHG) emissions. Emissions reductions from native forestry sequestration are already recognised in the New Zealand Emissions Trading Scheme (ETS) and it is 'shovel ready' to generate native forest offsets. 10,000 Ha of post-1989 native forest land would sequester 65,000 tonnes of CO2-e annually on average over 50 years, and would be eligible to earn 65,000 NZUs per year under the ETS. Native forestry also has a wide range of associated environmental, cultural, social and economic co-benefits. It is certainly possible for more native afforestation to occur at present, and within the existing policy framework; however, challenges do still exist. These include: a lack of awareness; limited access to capital; the complexity of the ETS; policy uncertainty; and some specific policy settings. The New Zealand business community can play an important role in solving these problems. Businesses can help influence government policy and have the capital and capacity to play a facilitating role in the market.

JEL codes

Q23, Q55

Keywords

Emissions Trading, Forestry, Native Forestry, Carbon Offsets, New Zealand, Pacific, Environment

Summary haiku

Natives get rewards
Can we make it easier?
Birds and climate win

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1 Introduction

This note aims to help firms looking to offset their Greenhouse Gas (GHG) emissions with native forestry. Native forestry has a wide range of associated environmental, cultural, social, and economic co-benefits and the credits it earns have a high degree of environmental integrity. Emissions reductions from native forestry sequestration are already recognised in the New Zealand Emissions Trading Scheme (ETS) and it is "shovel ready" to generate native forest offsets. This paper does not address "new" carbon reduction/removal options (soil carbon, marine carbon and carbon capture and storage). These face significant scientific and regulatory challenges. The "new" reduction options are discussed in a companion paper (Meduna 2016).

The ETS was introduced in 2008 as a part of the country's efforts to meet its Kyoto Protocol obligations.[1] Under the scheme, firms are required to acquire and then surrender New Zealand Units (NZUs),[2] to account for emissions associated with their activities. Currently, firms must surrender two NZUs for every three tonnes of carbon dioxide equivalent (CO2-e). By 2019, this will increase to one NZU for every tonne of CO2-e, as the "one-for-two" subsidy is phased out (Bennett 2016).[3] New Zealand is the first, and still the only, country to include forest landowners as mandatory participants in its ETS. As forests grow, they are eligible to earn NZUs for the carbon they sequester. Forestry also faces liabilities under the ETS for reductions in carbon stocks on forestry land, either from harvesting or deforestation.[4] The Afforestation Grant Scheme (AGS) and the Permanent Forest Sink Initiative (PFSI) are two other closely related policies that landowners can use to obtain finance and NZUs for afforestation efforts.[5] For more detailed information on the ETS, see Karpas and Kerr (2011), (Leining and Kerr 2016), and (Kerr, Carver, and Dawson Forthcoming).

Establishing new stands of native forestry (i.e. afforestation) has significant potential to help New Zealand firms meet their ETS commitments, contribute to voluntary programmes that go beyond New Zealand's target for corporate social responsibility reasons, and meet sectoral international commitments such as those under the International Civil Aviation Organization. Ten thousand hectares of post-1989 native forest land would sequester (and earn NZUs for) 65,000 tonnes of CO_2-e annually on average over 50 years, and would be eligible to earn 65,000

1 For more information see: https://www.climatechange.govt.nz/emissions-trading-scheme/ and Leining (2016).
2 An NZU is New Zealand's carbon credit, equivalent to one tonne of carbon dioxide.
3 "The current 50 per cent unit cost will increase to 67 per cent from 1 January [2017], then 83 per cent from 1 January 2018, with all sectors in the ETS paying the full market price from 1 January 2019" (Bennett 2016).
4 Harvesting is distinct from deforestation, in that deforestation is a conversion of forested land to another land use, while harvesting is the "removal of biomass from a site followed by reforestation (replanting or natural regeneration)" (Ministry for the Environment 2015).
5 The PFSI "promotes the establishment of permanent forests on private land". It enables landowners to earn carbon units for permanent forests planted after 1990 that were directly human induced. For more details see: https://mpi.govt.nz/funding-and-programmes/forestry/permanent-forest-sink-initiative/. The AGS promotes new planting by giving a $1,300/hectare grant to smaller (5-300 hectare) forests. The landowner receives the grant upon establishing the forest, and in exchange the Crown gets the carbon credits for the first ten years. For more details see: https://www.mpi.govt.nz/funding-and-programmes/forestry/afforestation-grant-scheme/.

NZUs under the ETS.[6] There is strong interest among a variety of stakeholders, including community groups and iwi, in planting more native trees for biodiversity, plantation forestry diversity, cultural and aesthetic reasons, and for erosion control. The financial returns from forestry have improved recently: the carbon price has rebounded;[7] there is more certainty around New Zealand's global commitments with the Paris Agreement;[8] and there are other payments for forestry available.

This note outlines the different options for obtaining credits via carbon sequestration by native forestry. It also outlines barriers to encouraging more native afforestation and suggests actions to overcome these. To help understand the issues, we have interviewed a range of stakeholders, including government officials, scientists, landowners, officials from certain iwi, and key individuals/organisations involved in native regeneration initiatives.

It is certainly possible for more native afforestation to occur at present, and within the existing policy framework; however, challenges do still exist. These include: a lack of awareness; limited access to capital; the complexity of the ETS; policy uncertainty; and some specific policy settings. The New Zealand business community can play an important role in solving these problems. Businesses can help influence government policy and have the capital and capacity to play a facilitating role in the market.

6 Assuming the average carbon sequestration per year over the 50 year "indigenous forest" lookup table from MPI (Ministry for Primary Industries 2015b). 85,000 hectares represent around1.5% of all planting since 1990, and around 0.11% of New Zealand farm land (Ministry for the Environment 2016).
7 $17.50 on 14 December 2016. The price of an NZU was as low as $2 in 2013, whilst other eligible units were priced at less than $1. See https://www.commtrade.co.nz/ for the latest spot price. See Ormsby and Kerr 2015 for a full treatment of the history of the carbon price in NZ.
8 Although New Zealand's Intended Nationally Determined Contribution (INDC) is still provisional on access to international markets and land accounting rules (New Zealand Government 2015).

The following tables summarise the key recommendations from our scoping study.

Table 1: Offset Options

	Science	**Regulatory Acceptability**
Current Options		
Native Regeneration Fencing off land near a native seed source and allowing it to revert to native forest. Actions: 1. Provide expertise and up-front finance for landowners in return for credits. 2. Work with researchers and other stakeholders to compile a shortlist of suitable land for regeneration efforts. 3. Pursue partnerships with other stakeholders and options that might deliver other revenue streams (e.g. honey, government incentives).	Strong	In ETS
Planting Native Trees Plantation or restoration Actions: 1. Provide expertise and finance for up-front planting costs. 2. Engage with experts to facilitate research into cheaper planting options. Encourage these groups to achieve consensus on key issues. 3. Utilise other incentives where possible.	Strong	In ETS
Options Currently Limited		
Riparian Planting Planting native trees along the banks of rivers when they are fenced. The aim is often to improve water quality. Actions: 1. Identify farmers willing to retire riparian areas wider than 30 metres. Provide expertise and finance for up-front planting costs. As this land is already being retired and fenced, it may prove a cost-effective option for native afforestation (although this is unlikely on high-productivity land). 2. Encourage research on the value of making credits available for narrower riparian planting.	Strong on carbon; water quality benefits less clear	Only in ETS if wider than 30 metres

Table 2: Policy Priorities

Policy Uncertainty 1. Encourage the government to clearly articulate its policy intentions for meeting New Zealand's Paris commitments. 2. Push for a multi-party consensus on as many of these intentions as possible.
Eligibility of Land for ETS Credits Request a definitive "line in the sand" ruling on what land is pre-1990 and what land is post-1989.[9]
Transparency Ask the government to make more ETS forestry data available.
Field Measurement Approach (FMA) Threshold Ask to lift the threshold for using the FMA to 500 hectares for native forestry land to reduce the cost and reporting burden.
Policy Intentions Clarify policy intentions for agricultural greenhouse gas emissions and Regional Council decisions around freshwater reform. This will help avoid perverse incentives to intensify or sustain livestock on land that would otherwise be attractive for native regeneration.
Right to Clear Native Forest 1. Investment certainty: clarify uncertainty surrounding landowner rights to harvest, mill, and export planted native forests.[10] 2. Land option value: consider a rule to give landowners the right to clear/log newly regenerated native forestry (e.g. post-2016).
Allow Mitigation Beyond New Zealand's International Commitments Ask for a mechanism to allow NZUs to be truly "cancelled", allowing participants to push New Zealand's mitigation efforts deeper, or to use these credits in voluntary markets. This would require an explicit commitment from government to take credits off the national emissions budget for our international commitments to be certain there is no double counting.
Address the Focus on Pine Stress the importance of ensuring afforestation incentives are flexible enough to reward native forestry (e.g. Afforestation Grant Scheme and other forestry incentives).
Native Forestry Certification for NZUs: Request that NZUs earned by native forestry be "tagged" with a native forestry certification. This may allow these NZUs to receive a premium in the market.
Riparian Forest Definition – Unclear Impact Ask to explore the possibility of amending the ETS forest definition to allow stands of forestry less than 30 metres wide to enter the ETS.

9 MPI could allow challenges to this, perhaps requiring landowners to meet the costs.

10 Clarify uncertainties around the definition of 'planted indigenous forests' under the Forests Act 1949, and the ability to re-plant planted indigenous forests after harvesting.

In this paper, we necessarily make some generalisations about native forestry. It's worth keeping in mind that there are a diverse range of tree species and modalities for their establishment/management and there is rarely a single solution. For more detail on native forestry establishment options see (Davis et al. 2009) and (Bergin 2012b).[11]

1.2 Benefits of Native Forestry

Native forest is established in New Zealand for a wide range of reasons and by a diverse set of actors. Broadly, the benefits of native forestry can be categorised as economic, environmental, social, and cultural. Briefly, some of these benefits are:[12]

- Economic
    - Harvesting timber
    - Honey production
    - Carbon credits;
    - Seed/cutting production
    - Tourism and recreation
    - Shelter/shade
    - Other by-products
- Environmental
    - Biodiversity
    - Soil stability
    - Carbon storage
    - Water quality
    - Regulation of flows
- Social
    - Aesthetics
    - Conservation
    - Recreation
    - Community engagement
- Cultural
    - Fulfilment of kaitiakitanga.

There is growing impetus to realise these benefits. For example:

11 Tane's Tree Trust also has a good technical handbook available here: http://www.tanestrees.org.nz/resource-centre/publications/.
12 This is covered in detail in other works (e.g., Hall 2016; Bergin 2012a; Ngapuhi 2007; and Davis et al. 2009).

- **Carbon sequestration**: Forestry provides an effective means for New Zealand to mitigate its emissions domestically. This has been made more attractive by the rebound in the carbon price, and since international units were no longer accepted in the NZ ETS.
- **Water quality**: Public concern has grown over the rising level of nutrient run-off into waterways (Parliamentary Commissioner for the Environment 2015).
- **Soil erosion**: The "area of steep, erosion-prone grassland that could benefit from afforestation" is estimated between 0.35 million hectares and 0.6 million hectares (Davis et al. 2009).

Many of the environmental/social/cultural co-benefits can be hard to value in dollar terms.[13] Government has been introducing policies to make it possible to earn a financial return for the provision of some of these benefits. An obvious example of this is the ETS; however, payments for other environmental co-benefits are also available. For example, the Erosion Control Funding Programme (ECFP) pays landowners in the Gisborne district up to $1,500/hectare for establishing forest on erosion-prone land.[14] Funds have also been made available by the Ministry for the Environment (MfE) and Fonterra for planting to improve water quality (Hall 2016).[15] These rewards, along with other payments from regional councils and trusts, help make establishing forestry financially viable.

The AGS and the PFSI are two policies related to the ETS that landowners can utilise. All three (AGS, PFSI, ETS) utilise the same core market and monitoring technology with slight differences in their contractual arrangements. Essentially, the AGS is a financing scheme that provides up-front payment for the first 10 years of carbon credits, whereas the PFSI puts a covenant on the land that prevents it being cleared (for at least 50 years).

The AGS provides a $1,300/hectare grant in exchange for the first 10 years of carbon credits.[16] This grant should be attractive for native forestry as its slow growth rate means the Net Present Value (NPV) of carbon credits over the first 10 years will likely be less than $1,300;[17] however, a maximum of 300 hectares of forest land can be registered per legal entity, per AGS application round, and the trees must be planted, rather than result from regeneration (Ministry for Primary Industries 2016a). The PFSI has a "focus on establishing permanent forests for storing carbon". In return for a covenant on the land that makes it harder for the landowner to clear the forest, there are lower reporting requirements under the PFSI programme (Ministry for Primary Industries 2015a). Land entered into the PFSI earns NZUs in

13 See Chapter IV of (Hall 2016) for an attempt to quantify the dollar value of some of these benefits at: http://pureadvantage.org/news/2016/04/22/our-forest-future/.
14 For details, see: http://www.mpi.govt.nz/funding-and-programmes/forestry/erosion-control-funding-programme/.
15 Fonterra's 'Living Water' project is being done in partnership with the Department of Conservation.
16 After this 10-year period, the forest land can be registered in the ETS and earn credits from then.
17 Based on the native lookup table, a 5% discount rate and a $20 constant carbon price the NPV of the first 10 years of carbon credits is $562. Even with a 0% discount rate and a $25 carbon price, the NPV is only $1,005.

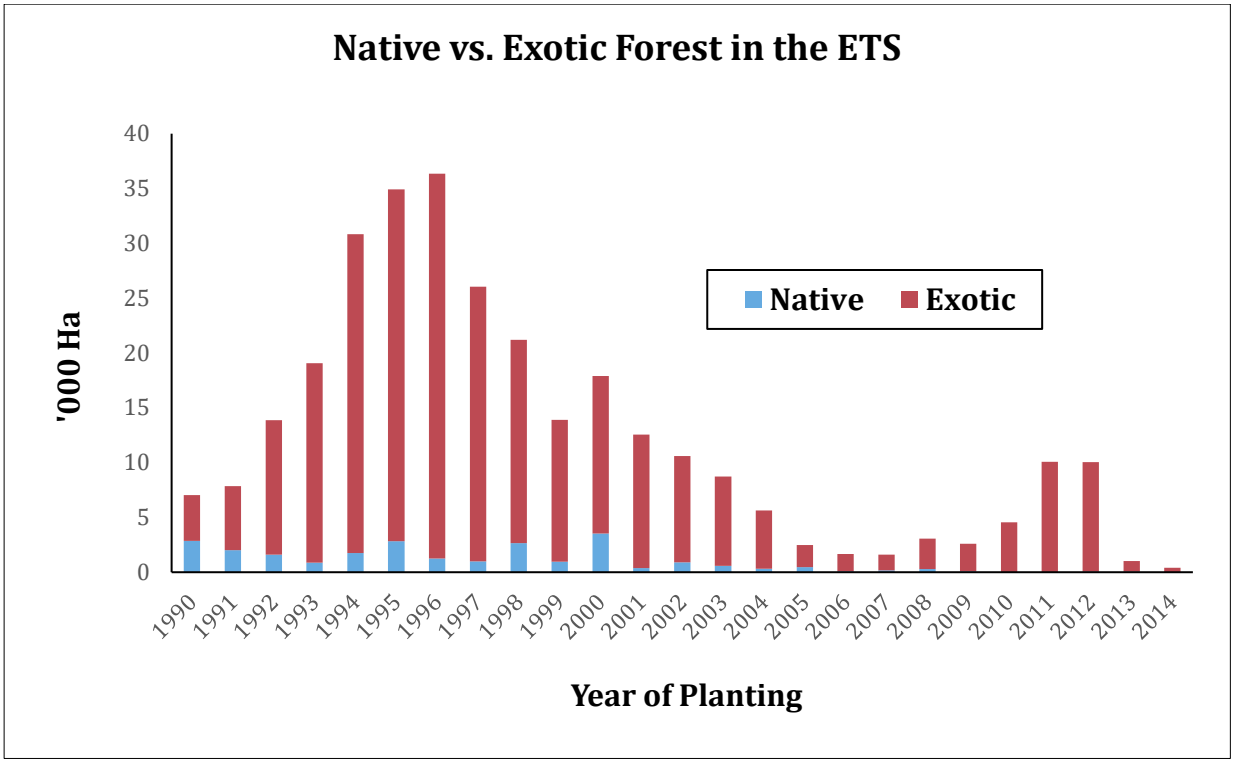
the same way as in the ETS. Land can only be entered into one of the PFSI or the ETS (Ministry for Primary Industries 2015a).

1.3 The Current State of Native Forestry in the ETS

Three hundred thousand hectares of forest land are registered in the ETS. Of this, 25,000 hectares are native (8%). Almost 90% of this native afforestation occurred between 1990 and 2000, as illustrated by Figure 1. There are also 12,000 hectares of forest land registered in the AGS and 14,000 registered in the PFSI.[18] It is unclear how much of the forest in the AGS and PFSI is native as these data are not available; however, Ollie Belton (Managing Director, Carbon Forest Services) stated that most of the PFSI forest land is native. Since 2008 only 500 hectares of native forest has been afforested and included in the ETS; this represents 1.5% of afforestation in the ETS since 2008 (Ministry for Primary Industries 2016b). Other afforestation of native forests has likely been included in the PFSI and AGS.[19] In terms of its composition, more than 70% of native afforestation is naturally regenerating Manuka/Kanuka ((Ministry for Primary Industries 2015b)).

18 AGS number comes from its website (https://www.mpi.govt.nz/funding-and-programmes/forestry/afforestation-grant-scheme/); PFSI number from correspondence with Peter Lough (Manager of Climate Change Operations at MPI).
19 In addition, since 2008, 300 hectares of afforestation has been registered in the PFSI. 12,000 hectares has been registered in the AGS. It is unclear how much of this is native forest.

Figure 1: Native vs. Exotic Forest Land in the ETS (by the Year it Originated)



Source: (Ministry for Primary Industries 2016b)

Native forestry is eligible to be registered under the ETS in the same manner as any other forest land in New Zealand. There are two principal means for establishing native forest: natural regeneration and planting.[20] It is possible for more native afforestation to occur under current policy settings; however, in this report we will examine some of the changes that could make it easier to establish native forest land.

David Bergin (Director, Environmental Restoration Ltd) and Ollie Belton (Managing Director, Carbon Forest Services) both felt that regeneration is relatively inexpensive, sometimes even zero cost. This is especially the case when it is done on marginal farmland where the opportunity cost is low. Planting natives on the other hand can be far more expensive. Unfortunately for both these options, they have far slower growth rates than exotic species such as pine (Ministry for Primary Industries 2015b).

2 Option 1: Native Regeneration

Regeneration of native forestry is the process by which land reverts either naturally, or with human assistance, back to native forestry. Regeneration requires a nearby seed source, and typically involves exclusion of livestock and animal pests (e.g. fencing), and possibly control of competing vegetation such as pasture and gorse (Davis et al. 2009) and (Bergin 2012b).

20 Combinations of these two also exist (e.g. enhancement planting of naturally regenerating land).

Regeneration is already eligible to earn credits in the ETS and is an inexpensive way to do so, albeit a slow one. Moreover, permanent, regenerating native forestry has large co-benefits: it provides a wide array of social amenities along with cultural as well as environmental benefits (e.g. biodiversity, erosion reduction, and water quality). David Bergin feels that regeneration is likely the only practical way to restore native forestry on a large scale (Bergin 2012b). He also thinks that landowners fear that their land will revert to invasive weeds such as gorse/blackberry rather than native forestry. This has sometimes happened when farmers tried to encourage regeneration. David believes that this might be due to lack of good advice, expertises and time/money to engage in the necessary spraying and pest control.

In some situations, planting can serve as a good complement to regenerating land. It can function as a seed source (especially for larger broadleaf species), and can also provide a nursery for regenerating natives. This nursery function can be fulfilled by smaller shrub species such as manuka that, depending on the site, can be relatively inexpensive to plant compared to later successional native trees.[21]

2.1 Opportunity

2.1.1 Cost-benefit

The key costs involved (where necessary) in native regeneration are: fencing, animal pest control, controlling competing vegetation, weed control, site preparation, and the value of the land (or the opportunity cost of its current use).[22] It is hard to provide a definitive cost for native regeneration. In some regions it is happening with no human assistance on unutilised land, and is thus effectively free. In other areas where extensive pest control is needed, there are no seed sources nearby, and there is competition from other land uses, it may cost a lot more. One study put the cost of native regeneration at just over $4,000/hectare (Davis et al. 2009).[23] This figure does not include the value of the land.

The value of carbon credits is a key monetary benefit. We estimate the NPV of the first 50 years of carbon credits at around $2,500.[24] The money from the carbon credits could be enough for regeneration to be profitable on low value land – especially when combined with payments for other environmental services (e.g. erosion control) – or where other non-economic benefits are realised. It's also possible that landowners might be able to earn a revenue stream from the recreation/leisure benefits or by-products (e.g. manuka honey) from their forest land (Hall 2016).

21 David Bergin.
22 David Bergin notes that even where regenerating land may initially revert to brush weeds such as gorse or broom, many of these sites will eventually succeed to natives over time.
23 Tables 6.2 and 6.3. David Bergin, a co-author of the paper, felt in many cases it could be done more cheaply.
24 Assuming a constant carbon price of $20 and a discount rate of 5% and MPI's native carbon sequestration lookup table. With a carbon price of $17.50 and an 8% discount rate this would be around $1,350. With a rising carbon price, it could be much higher.

2.1.2 Classification of Regenerating Land as Forest Land

Regenerating land can be classified as forest land, and thus begin earning carbon credits. Determining the year of forest establishment for regenerating natives can be difficult. Generally speaking: "Whenever there are areas of at least one hectare with sufficient forest species that it is likely they will, as they grow, exceed 30 percent crown-cover, the area is forest land" (Ministry of Agriculture and Forestry 2010).[25] In theory this might be the date when conditions formerly suppressing regeneration are removed (Ministry for Primary Industries 2015b). However, to classify an area that is naturally regenerating as forest land, MPI requires:[26]

1. Forest species to be present as seedlings (that are likely to survive)
2. Sufficient number of forest species to achieve 30% crown cover as they grow.

MPI may also request proof that:

3. Land management practices are in place to allow regeneration (e.g. fencing, pest control)
4. On land with conditions limiting tree growth (e.g. drought), regeneration is occurring (Ministry of Agriculture and Forestry 2010).[27]

2.1.3 Amount of Land Available

A 2005 report by Landcare Research estimated that 1.45 million hectares of marginal pasture lands would likely revert to native forestry following livestock removal (Trotter et al. 2005). A 2008 report by Landcare estimated the number at 1.55 million hectares and found that most of this land is in private ownership (Shepherd et al. 2008).[28]

2.2 Key Issues

2.2.1 Proving Eligibility

Our interviewees agreed that it can be difficult to prove regenerating native forest land is post-1989 (and therefore eligible to earn credits in the ETS). No definitive classification exists of land that is pre-1990/post-1989. This leads to time-consuming and costly arbitrations of different plots of land. This is burdensome for landowners and MPI, and the uncertainty can put off investors. No one feels that the current available maps delineating the pre-1990/post-1989 boundaries are perfect;[29] however, there is a broad consensus that a "line in the sand" would be

25 The age of the tree species in the forest is determined by treating all trees as if they regenerated in the year that regeneration began (Ministry for Primary Industries 2015b).
26 Ollie Belton said that in practice it is not possible to register land and claim credits if no tree seedlings are present. In unfavourable circumstances (e.g. strong pasture competition), this may take years or never happen at all.
27 (Ministry of Agriculture and Forestry 2010) notes that the "Year Zero" of forest establishment can be updated if circumstances change (e.g. if there is a drought or weed invasion occurs). The examples given refer to older stands of forest (e.g. regeneration that began in the 1990s) so it is unclear how this process will work with new land.
28 The estimates in Shepherd et al. (2008) for the amount of land that is the least productive, and thus the most likely to respond to a carbon price, need to be redone.
29 Thomas Paul and Peter Beets (Scion), felt the NZ LUCAS maps were "on the whole OK".

useful.[30] MPI could allow pre-1990 landowners to challenge this on a case-by-case basis, perhaps requiring landowners to meet the costs.

2.2.2 Carbon Measurement

There are two elements to consider here:

Reporting burden

Forest land over 100 hectares in the ETS must use the Field Measurement Approach (FMA)[31] to measure its carbon biomass (Ministry for Primary Industries 2015b). Nearly 90% of all native forest land registered in the ETS is greater than 100 hectares in size, and as such must use the FMA (Ministry for Primary Industries 2016b). The costs involved with the FMA are a potential barrier to native forestry joining the ETS. Peter Lough (Manager of Climate Change Operations at MPI), Craig Trotter (Principal Adviser for Spatial, Forestry and Land Management, Ministry for Primary Industries), and Ollie Belton agreed that in comparison with exotic plantation forestry, each measurement plot costs twice as much for regenerating natives. To compensate for this, MPI requires native forestry to measure half the number of plots.[32] However, as the income stream from regenerating natives is far lower than exotic plantation forestry, it can still be hard to cover the costs associated with the FMA.[33]

Accuracy of the lookup tables

On the other hand, forest land under 100 hectares uses the default ETS lookup table to measure the level of carbon in its forest. The native table is based on regenerating natives (Ministry for Primary Industries 2015b), and our interviewees agreed that its results are relatively consistent with those from the FMA.[34] However, many felt the default table could be improved (e.g. to account for stocking rates and regional variation),[35] especially with the data MPI has from the land using the FMA. There were also some concerns about how well the table would perform for more mature native forest land; however, this doesn't appear to be an urgent issue.[36]

30 MPI officials (Peter Lough, Craig Trotter); Tane's Tree Trust group (David Bergin, Debbie Birch, Caroline Wallace and Joris de Bres); Tindall Foundation (John McCarthy and Trevor Gray); Scion (Thomas Paul and Peter Beets); Simon Millar and Ollie Belton.
31 For more information on the FMA, see: https://www.mpi.govt.nz/growing-and-producing/forestry/forestry-in-the-emissions-trading-scheme/using-the-field-measurement-approach/.
32 Using fewer plots reduces the accuracy of the FMA. Both the 100-hectare area and the number of plots are somewhat arbitrary.
33 Ollie Belton claimed that to make it worthwhile a native forest would need to be at least 200-300 hectares. Fiona Carswell believed the 100-hectare threshold was set with the financial viability of native regenerating land in mind.
34 Peter Lough, Craig Trotter, Ollie Belton, David Bergin, Thomas Paul, Peter Beets and Fiona Carswell. From the ETS lookup table guide: "The tables represent the average increase in carbon stocks on a given hectare of land since the time regeneration first began… [the] tables allow for [the] gradual expansion in vegetation."
35 A stocking overlay is being considered as part of the ETS review.
36 Only forest land planted after 1989 can enter the ETS. Thus, the most mature native forest land in the scheme can be little more than 25 years old.

2.2.3 Land Option Value

Some landowners may be unwilling to allow natural regeneration on their land if they feel it can never be cleared, as this may reduce the value of their land. Existing native forestry is well protected in New Zealand. The Forests Act 1949, the New Zealand Forest Accord of 1991, and the Resource Management Act all protect mature native forest land from clearance or unsustainable logging (Karpas and Kerr 2011). These conservation efforts may have the perverse outcome of making landowners less willing to allow native forestry on their land as it will reduce its long-run option value. Some regional councils are looking at making it easier to clear/log newly established stands of native forest; however, a national commitment would give landowners/investors more confidence.[37]

2.3 Possible Actions for Private Actors

2.3.1 Immediate Actions

Provide expertise and up-front finance for landowners in return for credits

This could immediately generate more native reforestation project, even under existing rules. Barriers to valuable projects include: landowners' lack of understanding of ETS opportunities, rules, and risks; their inability either to manage administrative processes or to make small up-front investments in fencing and pest control.

Shortlist suitable land for regeneration effort

To help shortlist land for native regeneration, firms could support researchers and stakeholders to produce a detailed map of the overlap between land in proximity to a seed source, low-productivity land, post-1989 land, and land where other co-benefits (water quality, honey, cultural) might increase the value of regeneration. Until a definitive ruling on the mapping of post-1989 land is made, MfE's LUCAS maps are a good place to start.[38]

2.3.2 Encourage Government Action

Eligibility

Recommend the government agree to a "line in the sand" classifying land as either pre-1990 or post-1989. Pre-1990 landowners could be allowed to challenge this on a case-by-case basis, but they would have to meet the costs associated with this. This would reduce investor uncertainty and the burden on landowners. There seems to be broad agreement on this point.

Carbon measurement

Propose lifting the FMA threshold for regenerating native forests. The government has claimed that the lookup tables and FMA give very similar answers, so the fiscal risk associated with

[37] This may of course also allow more deforestation of existing native forests. The net effect would be unclear. The goal should be clarification of rules to avoid unnecessary uncertainty.
38 See: https://data.mfe.govt.nz/layer/2375-lucas-nz-land-use-map-1990-2008-2012-v016/.

raising the FMA threshold should be low.[39] Lifting the threshold from 100 to 500 hectares would reduce the existing ETS forest area impacted by the FMA from 87% to 59% and may facilitate more entry of small regenerating areas.[40]

Significant trade-offs are involved with this decision and it should not be made without consulting landowners and the government. One issue is that it will introduce different FMA thresholds for native and exotic forest land, and thus more complexity to the ETS. Another issue is that despite a large variability in native sequestration rates, there is currently only one table for all species, modes of establishment, stocking rates, and regions. This could pose a fiscal risk to the government and result in some participants earning fewer credits than they would using the FMA.[41] For this reason, some stakeholders, including Ollie Belton, oppose increasing the FMA threshold for native forest land. Indeed, Peter Lough (Manager of Climate Change Operations at MPI), informed us that some stakeholders have previously asked for the threshold to be lowered. Only the government has the data from the FMA to assess the level of the fiscal risk or how much some landowners may stand to gain or lose. The ETS lookup tables could also be adjusted.

This will lower the compliance/participation costs for smaller regenerating areas. Officials will probably wish to consider whether having a different threshold for native forestry may confuse participants.

Carbon measurement: accuracy of lookup tables

Support research initiatives to improve the accuracy of the lookup tables and to develop appropriate "overlays" for factors such as geography. This issue may become more important over time.

3 Option 2: Plantation Native Forestry

References to "plantation" native forestry mean tree species that are planted with the aim of harvesting the timber. There is a range of possible modalities for establishing plantation native forestry. In some cases, it will resemble exotic plantation forestry, where a single species is planted at regular intervals and is harvested in one go. In other cases, the forest may be planted and managed as a multi-species, multi-aged forest using continuous cover forestry principles (Barton 2008). Many groups, including some iwi, are interested in more "sustainable" harvesting

39 Native forestry makes up less than 10% of forest land registered in the ETS and earns credits at roughly one third of the rate of exotic forest land. Allowing native forest land to measure half as many plots when using the FMA also poses some fiscal risk, especially as naturally regenerating land is unlikely to grow in a uniform manner.
40 Government data may help to pinpoint the right threshold.
41 Forest owners who have planted native stands may be concerned about this. However, as discussed in Section 2, the ETS lookup tables indicate higher rates of growth than modelled growth of planted natives for the first 25-30 years. Besides, these landowners are likely to be rare, as planting over 100 hectares of native forest would be very costly.

methods and in extracting other by-products from the land (Hall 2016).[42] There has been very limited research into establishing "optimal" rotation lengths for different native forest species. One study modelled harvest rotations of 60-80 years, and 60 years is sometimes mentioned as a minimum (Steward et al. 2014). David Bergin feels that rotation lengths may need to be significantly longer than 60 years, especially given the quality of land on which native forestry is likely to be planted.

Like regeneration, plantation native forestry is already eligible to earn credits in the ETS. Even when it is not established/managed to resemble a "natural" forest (permanent forest cover and a diverse set of tree/shrub species), it can still sequester significant levels of carbon and provide important social, cultural and environmental co-benefits. Moreover, the harvested timber is likely to be highly valued. It's thus unsurprising that landowners are considering plantation native forestry.[43]

Planting natives for restoration purposes is covered in Section 5.

3.1 Opportunity

3.1.1 Cost-benefit

It's incredibly difficult to assess the profitability of a stand of native trees that may be harvested 60-100 years in the future. Growth rates, timber quality/prices and the carbon price must all be predicted.

One recent study has suggested that, under certain circumstances, kauri plantations may be profitable (Steward 2012). Some researchers doubt this, especially as many of the study's assumptions represent the "best case scenario" for native plantation (e.g. "good to very good site" and growth rates, low to zero cost for land, low establishment costs of around $4,000/hectare, and high value of final timber product).[44] This study doesn't assume any income from carbon credits or other ecosystem payments (e.g. nitrogen credits), which could only improve the prospects for plantation native forestry. However, it is still far from clear that profitability would be possible under an "average" set of assumptions even with ecosystem service payments.

As noted earlier, planting native forestry can be expensive; however, just like regenerating natives, the costs are situationally dependent. Cost estimates for larger native tree species suitable for timber harvesting (e.g. kauri, tōtara, rimu) range between $5,000-$60,000/hectare, excluding the cost of the land.[45] One study gives an estimate of $24,000-$36,000/hectare (Davis

42 Hall notes that this is in accordance with the Māori notion of interdependence (taupuhipuhi) with the land. Tina Ngatai (General Manager of Ngati Whakaue Tribal Lands Incorporation), expressed interest in this.
43 Interview with Tina Ngatai.
44 Gerard Horgan expressed doubts about the assumptions used in the study. See: http://pureadvantage.org/news/2016/06/21/going-native/ for more discussion on this.
45 Ollie Belton provided the low-end cost estimate ($5,000-$10,000 per hectare). He felt some of the higher cost estimates were appropriate for conservation/restoration planting, but with plantation forestry lower densities could be used and there would be efficiencies from planting a monoculture. Gerard Steward's study on Kauri plantation

et al. 2009);[46] another found that depending on the stocking rate, costs could range from $5,000-$66,000/hectare (Bergin and Gea 2007).[47] The stocking rate has the largest impact on establishment costs; however, lower stocking rates carry increased risk of seedling failure due to weed invasion and competition from existing vegetation.[48] We will cover the cost of planting cheaper shrub species (e.g. manuka/kanuka) later as they are not used for timber production. There is some scope to reduce these costs, some of which are briefly listed below:

- **Buying in bulk**: Our interviewees felt that the cost of native seedlings could drop if demand increased and nurseries had confidence in this level of demand. David Bergin (Director, Environmental Restoration Ltd) believed that a large increase in demand could drop seedling prices by as much as 30%.
- **Nurse crops**: Planting nurse crops (or utilising existing vegetation as a nurse crop) could accelerate the growth of trees and reduce establishment costs.[49]
- **Planting strategies**: Research is being done on reducing the cost of planting natives. Some of these strategies are showing promise. For example, (Davis et al. 2009) estimate that bare-root seedlings could reduce costs by nearly $9,000/hectare; direct-seeding onto the ground may be even cheaper (although there are major concerns about its viability on a large scale (Bergin 2012b)); employing lower stocking rates can reduce costs significantly. More research is needed on these options as they are still largely unproven and can involve significant trade-offs (e.g. lower stocking rates increase the chance of weed invasion and the native planting failing) (Davis et al. 2009) and (Bergin and Gea 2007).

Some of the revenue streams from native plantation forestry are:

- **Harvested timber and wood products**: Numbers on the value of native timber from plantation forestry are hard to obtain; however, it's clear it would be a premium and highly prized product.
- **Carbon**: Native planted stands of less than 100 hectares earn carbon credits in line with the MPI native lookup table (the same as regenerating natives). Larger stands, which must comply which the FMA under ETS regulations, may earn fewer credits in the short run than regenerating native forest land. This is due to the slow initial growth rates of large

forestry assumes a low establishment cost of around $4,000 per hectare (Steward 2012). David Bergin felt $30,000 per hectare was really the minimum, and that lower cost options using lower planting densities were at risk of failure from weed invasion. Scientists we interviewed at Scion and Landcare (Peter Beets, Thomas Paul and Fiona Carswell) generally felt the $20,000-$30,000 per hectare range was a reasonable estimate.

46 This is the cost to: purchase the tree stock, prepare the ground, plant the trees and then carry out ongoing weed control, pest control and site management for the first three to five years. It excludes the cost of the land. This study assumes a planting density of 4,444 trees per hectare (compared with 1,000 per hectare for pine plantation, which the study estimated costing $6,000 per hectare). See p. 63 Table 6.2.

47 This study excludes the cost of the land, fencing, and pest control. A stocking rate similar to the Davis report would imply a cost of around $30,000 per hectare. See p. 33 Table 2.

48 Interview with David Bergin.

49 Interviews with David Bergin and Ollie Belton.

native tree species (Kimberley, Bergin, and Beets 2014).[50] Over a longer period, the planted native forest will sequester more carbon than the ETS tables suggest; the value of this later storage will depend on the investor's discount rate, as illustrated by Table 3, and also on future carbon prices (a constant $20 price may be conservative). Where a nurse cover of planted native shrub species are used, these tend to grow faster than regenerating land and can potentially contribute to early carbon sequestration while inter-planted native tree species become established (Kimberley, Bergin, and Beets 2014).

- **Other potential revenue streams**: Manuka honey is frequently mentioned as a potential revenue stream for native forestry. Some suggest that native forestry could produce other by-products useful for "pharmaceuticals, nutraceuticals, biofuels, genetic resources" and more (Hall 2016). However, there is limited information about these other opportunities, and we are not aware of instances where they have been commercialised in a successful and ongoing manner.
- **AGS**: The NPV of the first 10 years of carbon credits from planted native forests is much less than the $1,300 payment from the AGS. It thus should make sense to utilise this when possible.
- **Payments for other co-benefits**: As discussed above.

Table 3: Net Present Value (NPV) of Carbon Storage in Native Forestry Stands by Discount Rate.[51]

	Regenerating Natives		**Planted Kauri[52]**	
Discount Rate	**5%**	**8%**	**5%**	**8%**
20 years	$1,673	$1,183	$1,065	$753
50 years	$2,479	$1,557	$3,244	$1,686

Source: Kimberley, Bergin, and Beets (2014) and Ministry for Primary Industries (2015b).[53]

There is a significant gap between the carbon value and the cost of establishing plantation natives. For planting to occur, the value of harvested wood products and ecosystem services other than carbon must be high enough to cover this gap.

50 The growth rates in this study are based on the average performance across a range of existing small native stands planted nationwide as surveyed by Tane's Tree Trust.
51 Assuming a constant carbon price of $20 per tonne.
52 Kauri is one of the fastest native species for sequestering carbon over a 40-80-year period. The annual carbon sequestration figures are interpolated from the 20, 40 and 60-year figures found in Table 4 of (Kimberley, Bergin, and Beets 2014), using the growth profile from the ETS lookup table.
53 The growth rates for regenerating natives come from the ETS lookup tables (Ministry for Primary Industries 2015b). The planted Kauri numbers come from the Tane's Tree Trust work (Kimberley, Bergin, and Beets 2014). As mentioned before, the growth rates in the Tane's Tree Trust study are based on the average performance across a range of existing small native stands planted nationwide.

3.2 Key Issues

3.2.1 Carbon Measurement

Again, there are two elements to consider:

Accuracy of the lookup table

From the limited available data, work by the Tane's Tree Trust (TTT) suggests that discrepancies exist between the growth rates of native plantation tree species (e.g. kauri, tōtara, rimu) and those found in the native lookup table (Kimberley, Bergin, and Beets 2014). This research predicts that native plantation forestry will sequester 30-60% less carbon than that implied by the lookup table over the first 20 years, but after 40 years will exceeds it by 10-100%.[54]

Reporting burden

For native plantation forestry that resembles exotic plantation forestry (monoculture, single-age, planted at regular intervals), the FMA is relatively easy to comply with. However, for those seeking to establish multi-species, multi-age, continuous cover native forestry, this will prove more difficult. It could even be as hard as naturally regenerating native forest land in some cases.

3.2.2 Investment Uncertainty

Poor profitability due to high costs, and the considerable uncertainty about potential revenues for native timber are the greatest barriers. Some farmers fear when they come to harvest their trees in 60 or more years, the national government or a local council may prevent them from doing so. Under the provisions in the Forest Act (1949), timber from planted native forest can be milled and exported. Furthermore, MPI has the ability to issue a "Planted Indigenous Forest Certificate" that verifies that the forest was planted and that can be used as evidence of this in the future.[55] However, the provisions of the Forest Act (1949) contain some ambiguities. Although a degree of natural regeneration is likely to occur within the forest before the trees are harvested, it is unclear in the Forests Act whether the timber from these naturally regenerating trees are also able to be milled and exported, as "timber from a planted indigenous forest". The Act classifies "planted indigenous forest" as land that was not "predominantly under the cover of indigenous forest" immediately before planting, so it is unclear if this would allow for multiple harvest rotations on the same piece of land (i.e. it is unclear whether a planted indigenous forest also has the status of 'indigenous forest land'). Furthermore, it is not certain that an activity approved under the provisions of the Forest Act (1949) will be permitted under the relevant regional and district plans under the Resource Management Act (RMA). Some of these plans may

54 The research finds that planted shrubs (e.g., manuka/kanuka) grow 40% faster than the lookup table would imply in the first 20 years; however, their growth plateaus very soon after that.
55 For more detail see: https://www.mpi.govt.nz/growing-and-producing/forestry/indigenous-forestry/harvesting-and-milling-indigenous-timber/.

have provisions to prevent or limit the clearing of native vegetation; this could limit the ability to harvest a planted indigenous forest.[56]

Another uncertainty is the future price of timber. Attempting to predict the price of such a rare and illiquid commodity is not easy. Even the nature of the wood itself is uncertain. The traditional supply and use of these species by Māori, and in European settlement times, came from large trees in old growth forests. The timber was likely to be from trees that were hundreds of years old and comprised mostly heartwood. Preliminary studies of wood properties from 60-70-year-old kauri/tōtara stands have found that heartwood formation is relatively slow, and timber from these stands will be predominately sapwood e.g. (Barton and Horgan 1980) and (Steward and Kimberley 2002).[57] However, there has been some work that suggests the properties of this sapwood compare well with those of heartwood and that it may be a valuable product (Steward and Mckinley 2005).

3.2.3 Conflicting Research

There are frequent disagreements and critiques amongst the various research groups interested in native plantation forestry over issues such as the cost of planting and profitability. There are benefits from robust academic debate; however, too much in-fighting can simply lead to paralysis. Wherever possible, we feel it would be useful for researchers to find common ground and move forward from there.

3.2.4 Capital Constraints

Many of the groups who want to plant more native forestry do not have access to sufficient capital to fund the up-front costs, even if they could make it viable in the long run. This should be less of an issue for business groups interested in purchasing offsets.

3.3 Possible Actions for Private Actors

3.3.1 Immediate Actions

Provide expertise and finance for up-front planting costs

This directly overcomes capital constraints and also reduces the uncertainty that comes from small-scale lack of expertise. In addition, if large-scale coordinated planted can be arranged, nurseries will have confidence that there is a long-term plan to encourage planting on a large scale; this should help bring down the cost per hectare. David Bergin felt that this could reduce the cost of seedlings by as much as 30%. It could also help fund research/trials to improve the efficiency of planting techniques. Other incentives, either from existing public programmes or from private sources should be utilised where possible. Large private ETS purchasers are more

56 Interview with Sean Bates (Forestry Analyst, MPI).
57 David Bergin indicated this in an interview as well.

likely to be able to manage projects that involve multiple actors and revenue streams, and hence lower costs or increase revenues.

Engage with experts to facilitate research into cheaper planting options

Encourage these groups to achieve consensus on key issues. Businesses could act as independent players and help bring research groups together, facilitating a dialogue to achieve consensus on important issues. This could provide a basis for researchers to move forward. It could also pay long-term dividends for a small investment.

3.3.2 Encourage Government Action

Carbon measurement

Support research that would develop species specific carbon lookup tables and appropriate "overlays" (e.g. stocking rate, geography). Officials are considering whether to investigate overlays as a future means of improving ETS carbon accounting.

Investment Uncertainty

Recommend the government attempt to remove any remaining uncertainty in the Forests Act around how the definition of a 'planted indigenous forest' interacts with other parts of the Act and with trees that naturally regenerate. This could be done by amending the interpretation section of the Forest Act (1949) to make it explicit that regenerating vegetation within a planted native forest won't prevent a landowner harvesting it[58] and to make it clear that when a native forest is harvested and replanted it is still classified as a planted indigenous forest. Work also needs to be done to ensure that regional RMA plans align with the Forest Act (1949). This policy would increase investor certainty.

4 Option 3: Riparian Native Forestry

Riparian zones are "strips of land bordering rivers, streams, lakes and wetlands" (Environment Canterbury 2011). This section covers native forestry that regenerates or is planted in these zones. Regional councils in New Zealand have long encouraged restoration of natives in riparian zones to improve water quality.[59] Riparian vegetation stores carbon and can have biodiversity, cultural and other environmental co-benefits. However, there are doubts over the alleged extent of environmental co-benefits from planting in riparian margins, and some trade-offs exist.[60]

[58] One way to do this would be to amend the definition so that the status of 'planted indigenous forest' extends to the whole planted area, as opposed to just the planted trees.
59 For example, the Taranaki Region Council (TRC) riparian management programme has been in place since 1996. See: https://www.trc.govt.nz/environment/freshwater/riparian-management/. This TRC scheme has resulted in the planting of 2,138 kilometres of stream bank with over 3.9 million native plants. Now, 64% of stream banks are vegetated where planting is recommended (Dairy NZ 2016).
60 Fiona Carswell (Chief Scientist, Landcare Research) had reservations.

Most of the water quality benefits may come from fencing off waterways from stock (Parkyn 2004).

Momentum is building on this issue, with the central government announcing last year plans to exclude milking dairy cattle "from water bodies by 1 July 2017" (Ministry for the Environment 2016).[61] While this won't mandate riparian vegetation, Dairy NZ has a voluntary "water accord" that calls for "riparian planting… where it would provide a water quality benefit" (Dairy NZ 2016).[62] However, much of this riparian planting will not be eligible to earn carbon credits as it won't be over 30 metres wide, which is the minimum width required to meet the definition for a forest under the ETS (Ministry of Agriculture and Forestry 2009).[63]

4.1 Opportunity

4.1.1 Cost-benefit

The costs and benefits are similar to those laid out in 3.3 and 3.4 (depending on whether the riparian margin is planted or if natural regeneration occurs). A key difference is that the cost of planting might be significantly lower. Many of these margins are being fenced (as a result of rules or voluntary actions) to exclude stock. This means that the opportunity cost of this land is essentially zero as it has no productive value, and there is no additional fencing cost. Based on these factors, (Daigneault, Eppink, and Lee 2016) estimate the cost of planting manuka to be $1,000/hectare and regeneration to be $0/Ha. However, the costs may be higher in some cases.

There are also a number of financial incentives available specifically to those planting in riparian buffer zones. In 2013, the government introduced a tax break for planting riparian margins on farmland.[64] Some councils are also trying to reduce the cost for farmers. For example, the Taranaki Regional Council "contracts nurseries to supply native plants to farmers at cost".[65]

4.1.2 Effectiveness of Riparian Vegetation

Riparian margins have significant water quality benefits. They reduce nitrogen leaching, phosphorus loss, and sediment loss (Parkyn 2004). Daigneault, Eppink, and Lee (2016) estimate that the benefits of fenced riparian margins, with or without active planting (the non-carbon benefits primarily come from fencing and stock exclusion alone), typically outweigh the costs

61 Dairy support, beef, and deer will be phased in between 2020 and 2030. Pigs are included in the July 2017 deadline. As of February 2017, dairy cattle are excluded from 96% of waterways on dairy farms (see: https://www.dairynz.co.nz/environment/in-your-region/sustainable-dairying-water-accord/).
62 The original water accord can be found here: http://www.dairynz.co.nz/environment/in-your-region/sustainable-dairying-water-accord/. Dairy NZ has also produced regional planting guides and a riparian planner tool which can be found here: http://www.dairynz.co.nz/environment/waterways/.
63 Forest land must have (or be able to obtain) "average crown-cover width of at least 30 metres" (Ministry of Agriculture and Forestry 2010).
64 "Riparian plantings by farmers will now be able to be deducted as an operational expense rather than being classified as capital expenditure". For detail see: https://www.beehive.govt.nz/release/tax-reform-encourages-conservation-planting.
65 For more detail, see: https://www.trc.govt.nz/environment/freshwater/riparian-management/.

involved by "between 2:1 and 20:1."[66] Their work estimated the "optimal width of the buffer" to be between 17 and 30 metres, depending on the set of assumptions used.[67]

A challenge for researchers is to differentiate between the benefits of stock exclusion and vegetation on the riparian margin.[68] (Parkyn 2004) notes that around 80% of the benefits in nitrogen, phosphorus, and sediment come from fencing alone. The findings of (Daigneault, Eppink, and Lee 2016) tend to support this: they find that a five-metre buffer reduces nitrogen leaching and phosphorus loss by 50% and sediment loss by 80%. They also find no improvement in nitrogen, phosphorus, or sediment loss from planting natives vs. regeneration.

Fiona Carswell (Chief Scientist, Landcare Research) also had reservations about the purported level of co-benefits associated with riparian vegetation – especially biodiversity, since native insect/plant diversity increases with planting but so too do predator densities. She felt fencing was a more cost-effective way to improve water quality.[69]

It therefore seems that any decision to engage in riparian planting/regeneration for carbon offsetting purposes should be independent from the purported benefits of riparian planting on water quality. The decision should be taken on the same basis as for any other piece of land (e.g. comparing the costs with the benefits we can confidently ascribe to native forestry).

4.1.3 Scale of the Opportunity

The length of permanent waterways located on agricultural and plantation forestry land is around 348,000 km (Daigneault, Eppink, and Lee 2016).[70] Having 30 metres of native trees along these riparian zones would result in roughly two million hectares of native forestry.[71] On average, over 50 years this would sequester 13 million tonnes of CO_2 equivalent (MtCO2e) (Ministry for Primary Industries 2015b).[72] These numbers are not meant to represent a realistic scale that riparian vegetation/forestry could achieve – on high productivity land, the opportunity cost of retiring this amount of land would be extreme, and most farmers will not be willing to do this. Rather, they are to illustrate that significant carbon offsetting opportunities exist along New Zealand's waterways.

66 Their work based their cost-benefit analysis on four benefits: greenhouse gas mitigation, nitrogen leaching, phosphorus loss, and sediment loss; and four costs: fencing, alternative water supply, afforestation, and opportunity cost of the land. They also considered biodiversity benefits, but didn't include them in their cost-benefit analysis.
67 This width is for either side of the waterway.
68 Very little current research differentiates between the benefits of fencing and riparian vegetation. We heard this from several interviewees (Fiona Carswell, Chief Scientist at Landcare Research; Thomas Paul and Peter Beets, both of Scion).
69 Fiona mentioned that grass was just as effective as trees for sedimentation, whilst the scientific research has not yet settled this issue for nitrogen/phosphorus run-off. David Bergin noted that even densely planted native riparian zones can have quite open bare ground beneath due to dense shade from canopy and wondered how that influenced the performance of grass vs. native trees/shrubs.
70 227,000km of this is on sheep/beef farms, 36,500km is in plantation forestry and 32,000km on dairy farms.
71 10% of this is from dairy and 73% from sheep/beef farming. The research does not consider afforestation along riparian zones on forestry land.
72 Taking the average sequestration rate of 6.5 tCO2e/yr from the native forestry lookup table. This figure would be as low as 1.2 MtCO2e in the first couple of years, and above 20 MtCO2e between 12-25 years.

4.2 Key Issues

4.2.1 ETS Forest Definition

As mentioned above, a key barrier to riparian forestry earning carbon credits is the current ETS definition of a "forest". The definition states that "land where the forest species have, or are likely to have, a tree crown cover at maturity of an average width of less than 30 metres" is not included as forest land eligible to earn credits under the ETS (Ministry of Agriculture and Forestry 2009). The resolution of satellite photography at the time the rules were established was a factor in the required width of a forest; new technology would now enable finer scale definition. The 30-metre average width requirement can be expensive to achieve when waterways border highly productive land. Another difficulty is the ETS requirement for forests to reach five metres in height, as the vegetation lower down the river bank, where floods are frequent, will necessarily be lower (Environment Canterbury 2011).

In our interviews, we learned of the government rationale for the ETS forest definition. First, easing the definition could bring areas such as shelter belts on farms into the ETS, leading to farmers facing a liability if they cleared them.[73] Second, and more importantly, expanding the land included in the forestry definition would result in some post-1989 forest land being re-classified as "pre-1990" and hence not eligible for reforestation credits. Third, any change to New Zealand's definition of forests would require updates to our carbon accounts provided for previous years in order to meet our international obligations, unless the government chose to accept a difference between ETS and international reporting.[74] Fourth, government officials felt that there had already been some progress on this issue by some regional councils' focus on water quality. Finally, government officials felt that there was uncertainty concerning the cost-effectiveness of establishing riparian vegetation.

Thomas Paul and Peter Beets (both at Scion) noted that where the optimal width of riparian margins was 30 metres or more, there would be no need to change the definition of a forest in the ETS. This seems possible based on the 17-30m optimal width findings from (Daigneault, Eppink, and Lee 2016). Thomas and Peter believed that if a rule change were required, it would be technologically feasible. They also felt it would be possible to reward riparian margins while leaving areas such as shelter belts as a matter for government.

73 It seems that this could be easily resolved by changing the forest definition in the ETS to apply only to reforestation, not deforestation.

74 Although depending on the outcome of the ETS review and the Paris rules, there is some chance the government may be willing to do this with other rule settings (e.g., averaging). This update may not be possible because 1990 satellite imagery of sufficient accuracy does not exist.

4.3 Possible Actions for Private Actors

4.3.1 Immediate Actions

Identify farmers willing to retire riparian areas wider than 30 metres. Provide expertise and finance for up-front planting costs. As this land is already being retired and fenced, it may prove a cost-effective option for native afforestation (although this is unlikely on high-productivity land). Encourage research on the value of making credits available for narrower riparian planting.

4.3.2 Changes to ETS forest definition

It may not be worth adding more complexity to the forestry ETS for riparian margins. It would however reduce the land available for reforestation credits elsewhere. If the government wishes to promote more riparian planting, it may wish to do this outside the ETS instead. This is already being done by Regional Councils through the Freshwater Reforms and through private sector efforts motivated by water quality concerns. If the forest definition were changed, it might be easier to leave liability for deforestation of areas such as shelter belts as a matter for government. Another potential solution would be to find a width that could include more riparian zones, but could still exclude shelter belts (potentially 15-20m). This would need to be done in consultation with landowners.

5 Other Native Forestry Options

Other techniques to establish native forestry do exist. With the exception of planting natives for restoration, these options are generally less common and not as well understood. This section discusses some of these options.

5.1 Planting Natives for Restoration (Non-Plantation)

Here, native tree species are planted with the aim of establishing them permanently. They may be established for a range of purposes (e.g. carbon, biodiversity, aesthetics, cultural significance, restoration programmes, and personal hobbies). These forests may in some cases resemble mixed-age, mixed-species, continuous cover native plantation forestry; however, they won't generally be managed to maximise timber yield. Thus, it's unlikely that common commercial silviculture practices (e.g. spacing, thinning) will be employed. It's also likely that these non-plantation planted natives will have a less managed - and thus more diverse - range of undergrowth species. Those planting this type of forest land often hope that they will resemble "natural" forests once they mature.[75] While it is a popular method (Davis et al. 2009), it is impractical and likely to be too expensive to do on a large scale (Bergin 2012b).

75 Although it's worth noting that many native tree species naturally form monocultures on selected sites, especially after man-made or natural disturbances.

The benefits from this approach are similar to those from regenerating native forest (3.3), except that some of those benefits may accrue more rapidly.[76] The costs can vary greatly, depending on the type of planting. Debbie Birch (Director, Ngāti Awa Group Holdings Ltd) put the cost of planting manuka at low stocking rates at $2,500-$3,000/hectare during our meeting with Tane's Tree Trust.[77] The paper by (Daigneault, Eppink, and Lee 2016) placed the cost of manuka at $1,000/hectare; however, it didn't include fencing costs. The work by (Davis et al. 2009) placed the cost of manuka/kanuka at around $25,000/hectare. Ollie Belton and David Bergin both put the cost of establishing "mixed" forests with larger broadleaf species in the $20,000-$40,000/hectare range, while the (Davis et al. 2009) work placed the cost at $40,000/hectare. It's worth noting that these estimates may not be comparing apples with apples. The higher cost estimates from (Davis et al. 2009), David Bergin, and Ollie Belton include site prep, all planting costs, weed control for three to five years after planting, and a relatively high stocking rate. For the lower cost estimates, however, we could find no detail behind their numbers.

As these forests tend to be more diverse and not planted at regular intervals, the costs involved with using the FMA will be high (for stands of over 100 hectares). Many actors planting these types of forests have broader goals than just carbon (e.g. restoration, biodiversity). In some cases, this will lead to the establishment of vegetation that does not sequester large amounts of carbon (e.g. tussock) so may not be valuable as a source of credits.[78]

5.2 Manuka/Kanuka Honey Forestry

Debbie Birch and others suggested that using honey production could be an effective means to establish native forestry. The shrub species used for honey production (manuka/kanuka) act as an effective nursery and the honey production provides an income to cover costs in the early years.[79] Planting manuka/kanuka costs a lot less than other planting options discussed above, especially with the low stocking rates often employed in honey production. When it is planted, it is eligible for an AGS grant of $1,300/hectare.

"Honey forestry" may not provide an ongoing flow of credits. Manuka flowers best during its first 20 or so years of growth, so honey producers have an incentive to clear manuka at this age and to replant a younger crop. Depending on what happens with the price of honey (and the carbon price), it's possible that a scheme intending to transition from honey to native forestry may never do so.

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76 As mentioned in 3.3., planting can be a good strategy to enhance regeneration activities.
77 David Bergin felt this may be possible, depending on the stocking rate and site, and with longer timeframes to achieve canopy coverage. He felt there would also be higher risks of infestation of problem weeds.
78 Interview with Jeffery Cornwell (Director of Planning and Support, Science and Policy Group, Department of Conservation): "If the natural state of a piece of land is tussock, [the Department of Conservation] wouldn't want to force" the planting of large conifer species.
79 In areas that are not close to seed sources, inter-planting of selected successional tree species (e.g., tōtara, kauri) will be required, which will increase the cost of establishment.

Other factors could reduce the attractiveness of this approach: The supply of honey is expanding rapidly and there are concerns about quality, which may depress the price; a "stocking rate" overlay to carbon measurement tables could be considered as part of the ETS review. This might affect this sort of planting, due to the low stocking rate often employed in honey production.

5.3 Exotic Forestry as a "Nursery"

Another option for establishing native forestry is to use exotic forestry as a nurse crop. There are a range of possible modalities for this (e.g. just planting and then leaving exotics, or removal of exotics within a few years of planting once they have allowed the establishment of planted or regenerating natives). Theoretically, this could provide the fast accumulation of carbon credits associated with exotic species, while natives become established in the gaps. There has been very limited work on this to date and it is not well understood in practice.[80] If more research proves this to be a cost-effective means of establishing natives it might be worth pursuing in the future.

5.4 Increasing Carbon Stock in Pre-1990 Forestry Land

This can be achieved in multiple ways (e.g. extending rotation cycles of plantation forestry, encouraging shrubland to regenerate by increasing pest control efforts or planting in seed sources, and even preventing the felling of existing shrub/native forest land). However, these activities are not eligible to earn carbon credits under New Zealand's current ETS. Depending on the final wording of the Paris Agreement, it appears these activities may be eligible under international rules.[81] These types of activities are unlikely to be eligible to earn NZUs any time soon.

Voluntary markets do exist for this sort of work and there are some actors in New Zealand operating in this space.[82] Depending on the final forestry rules from the Paris Agreement and the response of the New Zealand Government, it is possible that these types of activities could earn credits to be used towards international obligations. However, Sean Weaver (CEO, Ekos) did stress how hard and costly it was to get the different types of certification that may be needed.

80 Correspondence with David Bergin (December, 2016). For more detail see (Davis et al. 2009).
81 Some activities to increase carbon biomass on pre-1990 land were eligible to earn credits under the previous Kyoto rules (UNFCCC 2002).
82 For example, see Ekos: http://www.ekos.org.nz/rarakau---nz.html.

6 General Policy Issues for Facilitating Native Forest Offsets

6.1 Reduce Policy Uncertainty

Despite being less than a decade old, the New Zealand ETS is currently undergoing its third review (Leining 2016a). These reviews have generally "moderated" the price impacts of the ETS and delayed (indefinitely) biological emissions from agriculture (Leining 2016b). Additionally, New Zealand declined to sign up to the second Kyoto commitment period (CP2) (*New Zealand Herald* 2012). As a consequence, New Zealand was barred from using Kyoto units after 30 May 2015, and became a closed domestic-only scheme after this date (Leining 2016a). During the period when New Zealand was linked to the Kyoto market there was a dramatic collapse in the emissions price (Ormsby and Kerr 2015), and widespread concern over the integrity of some of the international credits that were purchased (Simmons and Young 2016).[83] This was followed by a gradual recovery in the emissions price following the announcement of our withdrawal. There is uncertainty about whether, and how, international units may be used in the future and what New Zealand's accounting methods for forestry will be under the Paris Agreement. What might happen if there is a change of government in 2017 is a matter for speculation.

It's thus unsurprising that less afforestation has occurred than predicted by models assuming constant/increasing carbon prices and policy stability (Kerr, Carver, and Dawson Forthcoming). Indeed, David Rhodes (CEO, NZ Forest Owners Association) said that "people have been burned by this and are very distrustful" of government policy. Ollie Belton also felt that some market participants had been driven away by policy uncertainty. This is especially important for forestry, where land use decisions are being made with such large time horizons.

6.2 Reduce Complexity

There is a perception among some stakeholders that the ETS is too complex, especially for businesses/landowners already busy with other day-to-day operations. This complexity, and the resulting lack of understanding of the ETS among landowners, may be a key reason why very little native afforestation is occurring, even though it is possible under current conditions.[84] Some stakeholders found this complexity an issue when deciding how to respond to ETS incentives. For example, Tina Ngatai (General Manager of Ngati Whakaue Tribal Lands Incorporation) expressed concerns about how to value carbon credits in their accounting practices, and uncertainty regarding what types of forest land were eligible to earn carbon credits. We also encountered this uncertainty when talking with the Department of

83 For more detail on this see (Karpas and Kerr 2011), (Ormsby and Kerr 2015), (Leining and Kerr 2016) and (Kerr, Carver, and Dawson Forthcoming).
84 Interviews with David Bergin and Ollie Belton and Tane's Tree Trust group.

Conservation, which has received an application to contract out the carbon credits from its land.[85]

6.3 Unlock Other Sources of Funding

Dayle Hunia (Management Consultant, Kōtuku Systems Ltd) felt there were sources of funding that could be used for native afforestation but were currently underutilised. One example of this is the restoration trusts established after the RMA consenting process (e.g. Mighty River Power, Genesis, Trustpower).

6.4 Increase Transparency

A number of key stakeholders raised their dissatisfaction with the government's refusal to share key information with them.[86] Their requests for information fall broadly into two categories. First, researchers simply want access to more data. For example, giving access to data collected from the FMA might allow them to create new lookup tables for native forestry; data on age classes of forestry in the ETS and existing liabilities against these forests would allow better prediction of NZU flows. The second request is for more transparency around government policy and how it intends to meet its international mitigation targets. Among other things, this would help to reduce investment uncertainty and particularly uncertainty about the future ETS price. Some information in this second category may be sensitive and it appears that some is still undecided by the government (e.g. international forestry rules are still being finalised and the government will need to choose its response to these); however, many stakeholders felt the government could at least give general guidance.

6.5 Reduce Focus on Pine

Pine is fast growing, cheap to establish, and accounts for over three quarters of forest land registered in the ETS. In this light, the focus on pine is understandable. However, some afforestation incentives needlessly exclude native forestry. For example, the AGS is only available for planted forest land.[87] This can be planted natives but it cannot be natural regeneration – the lowest cost native option. Tina Ngatai mentioned another incentive at the regional council level that exclusively paid for the planting of pine. These incentives could be made more flexible to reward those allowing native regeneration or planting native forestry, without imposing a great fiscal cost on the government.

85 Conversation with Jeffrey Cornwell, Director of Planning and Support, Science and Policy Group at the Department of Conservation.
86 We have heard that the Climate Change Act has a privacy provision.
87 The AGS promotes new planting by giving a $1,300/hectare grant to smaller (5-300 hectare) forests. The landowner receives the grant once the forest is established, and in exchange the Crown gets the carbon credits for the first ten years. See: https://www.mpi.govt.nz/funding-and-programmes/forestry/afforestation-grant-scheme/.

6.6 Clarify Policy Intentions

Clarify policy intentions concerning agricultural greenhouse gas emissions and regional council decisions around freshwater reform. This would help to remove perverse incentives to intensify or sustain livestock in the hope of receiving future compensation on land that would otherwise be attractive for native regeneration.

6.7 Facilitate Voluntary Action

6.7.1 Mitigation Beyond New Zealand's International Obligations

It is possible to voluntary cancel a specific NZU in the New Zealand ETS Registry. The number of NZUs in the ETS is thereby reduced. However this cancellation does not currently affect the amount of emissions reported to the UNFCCC by the New Zealand Government, or the precise definition of our emissions target under our UN commitments including New Zealand's NDC. To allow New Zealanders to strengthen our mitigation efforts, or to use these credits in voluntary markets without "double counting" the Government would need to make an explicit commitment to take credits off the national emissions budget for our international obligations. However, this could make New Zealand into a target for generating credits for voluntary international markets. This would need to be managed to avoid unwanted impacts on New Zealand's ETS.

6.7.2 Native Forestry Certification:

At present, there is no easy way to verify that a carbon credit comes from native forestry. While this could be done by a private third party, the government is well placed to fix some issues that make this harder (e.g. we have heard that PFSI labels in the ETS registry do not always stay with credits when they are traded).[88] This certification could potentially be reserved for permanent forest sinks by limiting it to PFSI participants. It would also allow the market to decide if there should be any premium for these credits. This should be easy to do – in the current registry there are credits tagged to certain projects. It would give companies a way to certify that their offsets come from native forestry.

88 Interview with Ollie Belton

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