Review of the royalty regime for minerals

Discussion paper

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Ministry of Business, Innovation & Employment

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Introduction

About this discussion paper

1. This paper:

   a. explains the background to the review of the royalty regime for coal, gold, silver, platinum group elements (PGE), ironsands, phosphates and seafloor massive sulphides (SMS)

   b. explains the modelling work carried out by the Ministry of Business, Innovation and Employment (the Ministry) to assess a number of different royalty options, including the assumptions used and the key objectives against which the options have been assessed

   c. sets out the Ministry's recommendations for a new royalty regime

   d. invites you to make submissions on those recommendations.

The wider context: Review of the Crown Minerals Act regime

2. In March 2012 the Ministry of Economic Development[1] released a discussion paper titled *Review of the Crown Minerals Act 1991 Regime*.[2] One of the proposals put forward in that discussion paper was a review of royalty rates for Tier 1 minerals.

3. The main Tier 1 minerals were defined in that paper as large commercial gold, silver, coal, ironsands, platinum group elements, phosphates and seafloor massive sulphides.

4. There are two reasons for reviewing the royalties for Tier 1 minerals:

   a. At present the royalty rates that apply to ironsands, phosphates and seafloor massive sulphides are not transparent, as these rates may be decided at the Minister's discretion

   b. Commodity prices for gold, silver and coal have increased significantly since 2008, when the royalty rates for minerals were last reviewed.

Terms of reference for the review of Tier 1 royalties

5. This review of the royalty rates for Tier 1 minerals focuses on the following two questions:

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[1] This paper refers to the Ministry of Economic Development (MED) in relation to events before July 2012. MED became part of the Ministry of Business, Innovation and Employment from 1 July 2012, and references to "the Ministry" refer to that new Ministry.

[2] Available at www.med.govt.nz/sectors-industries/natural-resources/oil-and-gas/review-of-the-crown-minerals-act-regime

a. Is the Crown receiving a fair financial return from the development of its mineral estate?

b. Is the royalty regime internationally competitive, particularly when compared to Australia?

6. Any changes to the royalty rates will apply to new permits only. For existing permits, licences and privileges, the current royalty rates will continue to apply.

7. The review takes into account the tax regime that applies to mineral miners.

8. This review is for royalty rates applied to coal (including underground coal gasification), gold, silver, platinum group elements (PGE), ironsands, phosphates and SMS.

Current royalty system for Tier 1 minerals

9. The current royalty rates for the Tier 1 minerals being reviewed are as follow:

   a. **Coal** - A unit-based royalty of:

      i. $1.40 per tonne for hard and semi-hard coking coal

      ii. $0.80 per tonne for thermal and semi-soft coking coal

      iii. $0.30 per tonne for lignite.

   b. **Gold, silver and PGE** - A tiered ad-valorem royalty (AVR) of:

      i. one percent for a permit with annual net sales revenues of $1.5 million or less

      ii. two percent for a permit with annual net sales revenues of more than $1.5 million.

   c. **Underground coal gasification, ironsands, phosphate and SMS** – Royalty rates for these minerals are set at the Minister's discretion.

10. Coal royalties are not payable if the royalty calculated for a calendar year is less than $2,000. For gold, silver and PGE, royalties are not payable if the net sales revenues from a permit are less than $200,000 for a calendar year.

11. Coal mines are also subject to the Energy Resources Levy (ERL). The ERL is $1.50 per tonne for South Island lignite mining and $2.00 per tonne for all other opencast coal mining. The ERL does not apply to underground coal mining.

Objectives of an optimal royalty and fiscal regime

12. In March this year the Ministry of Economic Development put forward for discussion four objectives for an optimal royalty and fiscal regime (in *Review of the royalty regime for petroleum: Background to the regime and options for change*[3], a companion paper to the *Review of the Crown Minerals Act Regime* discussion paper). Those same objectives have been retained for the review of the Tier 1 minerals royalty regime and have been used as the basis for the modelling work carried out for the review:

    a. **Royalty rates provide a fair return to the Crown as owner of the resource**: Royalty regimes that place the Crown, as owner of the resource, in the position of a residual creditor are unlikely to be considered fair, even if they may be efficient. Revenue-based, unit-based or hybrid revenue/profits-based royalty regimes provide the Crown with a guaranteed return as soon as production begins.

       Obtaining a fair financial return from the development of the Crown's mineral estate is a key element of a purpose statement that would be added to the Crown Minerals Act under proposed amendments.[4] This objective has therefore been weighted far more heavily than the other three objectives for the purposes of this review.

    b. **Royalties should be neutral and non-distortionary**: The system should not have the effect that developments that are economic before a royalty is applied become uneconomic after the application of a royalty.

       In the modelling work for this review, the results for this neutrality objective were heavily influenced by the underlying economics of mine development. The results indicated that the application of a royalty only affected mine developments at the margins, and then only in the most highly marginal mine development scenarios. Accordingly, this objective has not been weighted heavily in formulating the recommendations in this paper.

    c. **Royalties should provide appropriate risk-sharing between private investment and the Crown**: In assessing royalty options against this objective, the Ministry has measured the extent to which each option improves returns to mining companies for marginal developments while at the same time improving returns to the Crown in a high-price environment.

       Whether risks are shared appropriately between private investment and the Crown affects mining companies' perceptions of New Zealand's international competitiveness. The Ministry has weighted this as the second most important objective, after the fair financial return objective.

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[3] Available at www.med.govt.nz/sectors-industries/natural-resources/pdf-docs-library/oil-and-gas/crown-minerals-act-review/review-of-the-royalty-regime-for-petroleum.pdf.

[4] See the Crown Minerals (Permitting and Crown Land) Bill (introduced 20 September 2012), clause 6.

d. **Royalties should be simple to administer for both the Crown and industry**: Unit-based royalties are administratively simpler than revenue-based royalties, which are in turn simpler than profits-based and hybrid-based royalties.

The Ministry has not weighted this objective heavily in this review, for the reason that very few permit holders have chosen to move from the 1996 Minerals Programme for Minerals (MPM) to the 2008 MPM, even though it would apparently be in their financial interest to do so.[5]

[5] Since 2008 only four coal permit holders, six gold and silver permit holders and one PGE permit holder have moved to the administratively simpler royalty regime in the 2008 MPM. There continue to be 50 coal permit holders, 306 gold and silver permit holders, and 33 PGE permit holders under the 1996 MPM.

Models used by the Ministry to benchmark royalty regimes

Introduction: The Ministry's approach to modelling

13. The Ministry assessed the commercial viability of mining various mineral deposits using a set of discounted cash flow models that include all the relevant income and costs a mining company would expect in the course of exploring, developing and producing from a mineral deposit.

14. Models were built to test revenue shares for the Crown, the operator and the landowner across a range of royalty regimes. "Commercial viability" for a mining operation has been defined as where the operation has a positive net present value (NPV), using a discount rate of 10 percent.

15. Separate models were developed for each mineral type, because the approaches to mining each mineral and the relevant market characteristics are so different. The exceptions were gold and silver: these were modelled together because silver is a by-product of gold production.

16. The financial models are driven by a set of universal assumptions (for example, exchange rates and discount rates) and a set of mineral- and mine-specific assumptions (for example, commodity prices, capital and operating expenses, tax rules, and freight and decommissioning costs).

Sources of the assumptions used

17. Production profiles for specific scenarios were derived from a resource size estimate and spread across an appropriate length of time (in the order of 10 to 25 years). Further assumptions were made in relation to the amount of time spent on exploration. From these exploration and production profiles, revenues and expenses were calculated from cost and commodity price estimates, and capital and exploration costs were calculated and depreciated over the appropriate length of time using the appropriate tax rules. Operating cash flows to the operator were then calculated, and taxes, royalties and any payments to the landowner were calculated and deducted.

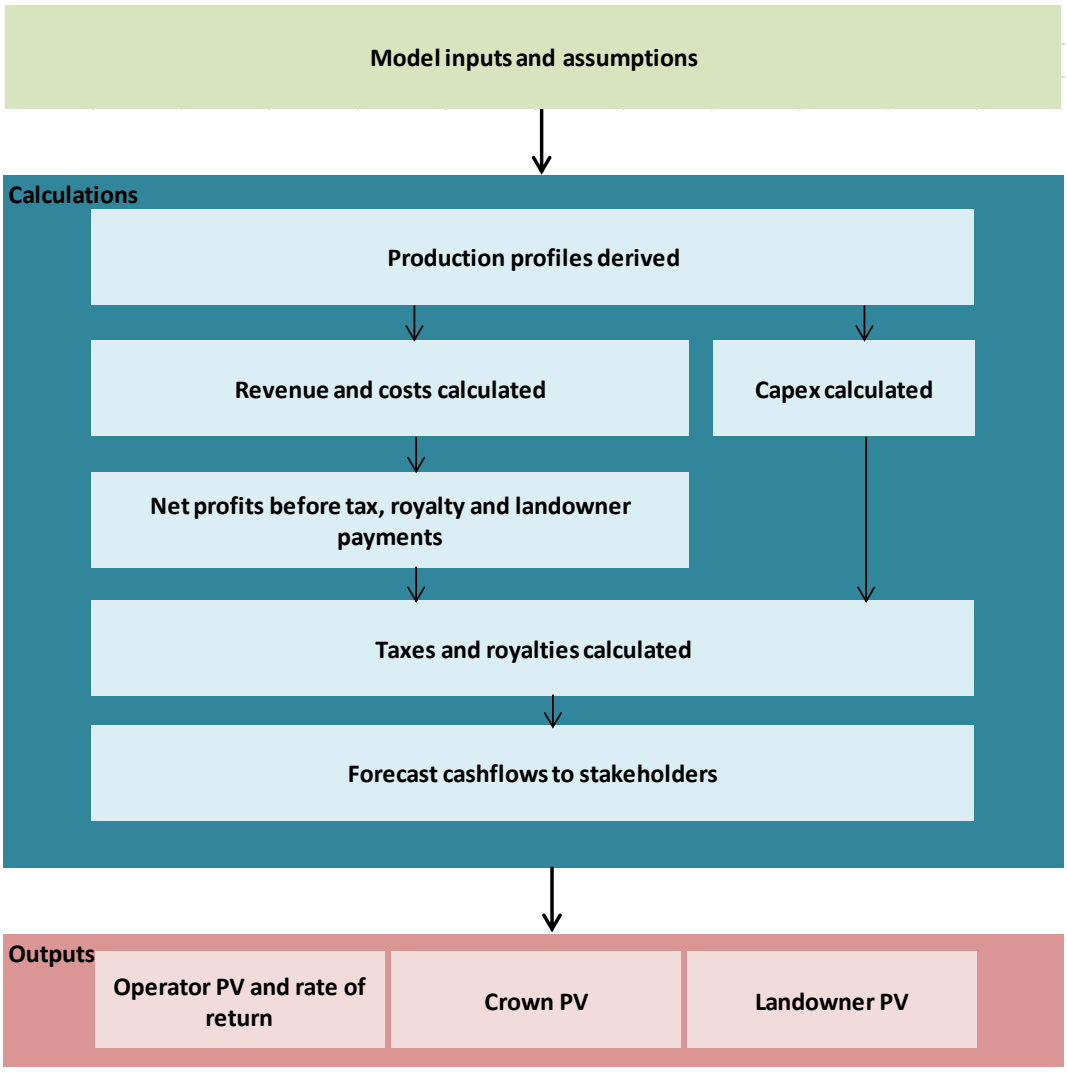
18. Those calculations resulted in a series of nominal post-tax cash flows to the operator, royalties and taxes to the Crown and, if applicable, payments to the landowner. These cash flows have been discounted at a consistent discount rate of 10 percent to determine the present value of the mine to the operator, the Crown, and, if applicable, the landowner. An overview of the modelling process is shown in Figure 1.

Use of monte carlo simulation

19. As a limited number of scenarios cannot cover all plausible cases, Monte Carlo simulation analysis was done on the hypothetical mines modelled. This produces a large number of plausible combinations of input variables, and has allowed the Ministry to investigate the effect of different royalty structures and rates on the probability of commercial success.

20. Each simulation was run 500 times for every combination of royalty and mine size. The resulting distributions of present values for the Crown, operator and landowner were analysed and used to derive commercial success rate probabilities. A P90 estimate represents the 10th percentile of observations from the model, and a P10 estimate represents the 90th percentile of observations.

Figure 1: Overview of modelling process



Sources of the assumptions used

21. The assumptions used in the models were derived from a number of key sources. In particular:

    a. **Taxation rules** used were the proposed new rules resulting from Inland Revenue's tax review for "specified minerals". Those "specified minerals" include all minerals covered by this Tier 1 royalty review, except coal. Details of the proposed new tax rules are set out in Appendix 1.

    b. **Land access fees** were sourced from major industry players and selected tenement consultants.

c. **Operating and capital expenditure estimates** were sourced from major industry players, work undertaken for this review by KPMG, internal work undertaken by the Ministry on ironsands, and, in the case of seafloor massive sulphides, work undertaken for New Zealand Petroleum & Minerals (NZP&M[6]) by Transfield Worley.

d. **Commodity price estimates** were sourced from equity research and discussions with major industry players.

Assessment of objectives

Fair financial return

22. For the purposes of this review the Ministry considers that a "fair financial return" to the Crown means the highest level of Crown revenue across a range of scenarios and sensitivities (such as commodity prices and exchange rates), within the following constraints:

    a. the Crown receives a guaranteed minimum payment at the outset of production

    b. total Crown share is internationally competitive measured against Australia, Canada and other comparable jurisdictions.

23. In general, the Ministry considers that an appropriate royalty rate may be one that provides a total Crown share (royalty plus taxes) of somewhere between 30 to 40 percent of accounting profits. This is lower than the 42 percent Crown share for petroleum: the difference is meant to reflect the greater regulatory hurdles for mining compared with petroleum (the landowner veto in particular).[7]

24. The fair financial return objective limits the types of royalty regimes that the Ministry has chosen to review. The Ministry prefers revenue-based, profits-based or hybrid revenue/profits-based royalty mechanisms. It does not favour unit-based royalties, because they are economically inefficient, nor resource-rent type royalties, because of their administrative complexity. Previous royalty reviews have undertaken a thorough assessment of different royalty types and their relative advantages and disadvantages. The Ministry is satisfied that the theoretical assessments undertaken still hold and that there is no need to undertake a further assessment.[8] A discussion of some of these different royalty types and their relative merits and disadvantages is provided in Appendix 8.

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[6] NZP&M is a branch of the Ministry of Business, Innovation and Employment.

[7] The Crown share of 42 percent for petroleum is calculated as the sum of the 20 percent APR plus 28 percent on the remaining 80 percent of profit (that is (0.2 + (0.8 * 0.28)). Using the same method for minerals and applying a hypothetical 10 percent APR would give a Crown share of 35 percent (that is, 0.1 + (0.9 * 0.28)).

[8] *Analysis of Cost-Sensitive Royalties Applied to the New Zealand Resource Sector,* Acil Australia, September 1989; *Resource Pricing: Rent Recovery Options for New Zealand's Energy and Mineral Industries,* Ministry of Energy, December 1989; *Crown Owned Minerals: Allocation and Pricing,* Acil

Neutral / non-distortionary

25. Royalty regimes have been assessed against the "neutral / non-distortionary" objective by assessing their impact on commercial success rates compared with the current royalty regime. A mine is defined as a "commercial success" if the internal rate of return (IRR) of the mine development is 10 percent or greater.

Appropriate risk-sharing

26. Royalty options have been assessed against this objective by taking the relative upside to the miner in each P90[9] scenario (in terms of lower royalty payments made to the Crown relative to current royalty levels) and then the upside to the Crown in each P10[10] scenario across royalty options. In order to provide an objective and consistent methodology across each commodity modelled, no weighting has been given to the relative importance of upside to the miner in each P90 scenario versus upside to the Crown in each P10 scenario.

27. An important caveat to the assessment of the downside risk of different royalty options to the miner in a P90 scenario is an assessment of the profitability of the mine development. A mine is defined as a "commercial success" if the internal rate of return of the mine development is 10 percent or higher. The Ministry has further tested projects against a higher discount rate of 15 percent. If the net present value of the mine development to the operator is positive at a discount rate of 15 percent (that is the project IRR is more than 15 percent), then it has been assumed that the mine development would proceed in all circumstances. If the net present value to the operator is negative with a discount rate of 15 percent, but positive with a 10 percent discount rate, the mine development is considered marginal but it is still assumed that it would proceed.

28. If there is no upside to the miner in the P90 scenario but the mine development scenario remains highly profitable to the miner, then the "downside risk" to the miner has been discounted.

Administrative simplicity

29. The revenue-based royalties were ranked higher for administrative simplicity than pure profits-based royalties, which in turn were ranked higher than the hybrid revenue-based and profits-based royalties.

Australia, October 1991; *Crown Minerals Act 1991: Evaluation of Allocation and Pricing Regimes,* Ministry of Commerce, September 1992. The Minerals Programme for Minerals 2008, Appendix 1, Part 3 also summarises the different royalty mechanisms.

[9] A P90 estimate represents the 10th percentile of 500 observations from the model.

[10] A P10 estimate represents the 90th percentile of 500 observations.

Royalty options reviewed

30. The Ministry selected the following five royalty options to be assessed under this review:[11]

    a. **AVR 1**: a one percent ad valorem royalty

    b. **AVR 2**: a two percent ad valorem royalty

    c. **APR**: a 10 percent accounting profit royalty. A five percent accounting profit royalty results in outcomes that are very similar to a one percent AVR. The Ministry was keen to test outcomes with a higher APR

    d. **Hybrid 1**: a hybrid of a one percent AVR and a 10 percent APR

    e. **Hybrid 2**: a hybrid of a two percent AVR and a 10 percent APR.

31. In the case of coal and gold, the Ministry has added a materiality threshold. For coal, the 10 percent APR would only be payable by those coal mines with annual accounting profits of more than $5 million, while for gold the 10 percent APR would apply to those mines with annual accounting profits of more than $2 million. The purpose here is to tailor the royalty regime to a scenario where the range of future mines to which this royalty might apply is similar to the current range of producing and royalty paying coal and gold mines. Both the coal and gold sectors are characterised by a few highly profitable and productive mines and then a long tail of much smaller, less profitable mines. The materiality threshold is designed to distinguish between these two types of operations.

32. In the case of PGE, ironsands, phosphates, and SMS, any future mine developments would have to be very large operations. Accordingly, no materiality threshold has been added.

[11] The different types of royalty options are explained in Appendix 8.

Recommended changes to Tier 1 royalties

The Ministry's recommendations

33. The Ministry recommends the following new royalty rates:

    a. For **new coal, gold, silver, PGE, ironsands, phosphates and SMS permits**, a hybrid royalty of the higher of a two percent AVR or a 10 percent APR. Coal and gold would be subject to the following materiality thresholds before the 10 percent APR would apply:

        i. For coal – annual accounting profits of $5 million

        ii. For gold – annual accounting profits of $2 million.

    b. For **underground coal gasification**, a hybrid of the higher of a one percent AVR or a 10 percent APR. This is a holding rate which would be reviewed once the project economics of underground coal gasification become clearer.

    c. For coal, gold, silver, PGE, phosphates, ironsands and SMS, the Ministry recommends retaining the existing threshold of $200,000 of annual net sales revenues, after which permit holders are liable to pay a royalty.

    d. The proposed new royalty rates would apply to new permits only. For existing permits, licences and privileges, the current royalty rates would continue to apply.

Why the hybrid options?

34. The results of the modelling carried out by the Ministry included some consistent themes:

    a. The **hybrid options performed best under the fair financial return objective** as they provide both a guaranteed minimum return at the outset of production and upside to the Crown in cases where the mine is highly profitable. In contrast, the pure APR option performed poorly against this objective, mainly because it fails to deliver a guaranteed minimum return to the Crown at the outset of production. Given the high capital requirements of mine development, the modelling indicated it could take several years before a pure APR royalty regime would result in a royalty payment to the Crown in some mine development scenarios.

    b. The **pure APR royalty performs best against the "neutral/non-distortionary" and "appropriate risk-sharing" objectives**. However, the modelling highlighted the overwhelming importance of commodity prices, development costs and exchange rates to the overall economics of the mine. The number of additional mines under the pure APR option relative to the other royalty options was negligible across all the commodities modelled. For this reason, the "neutral/non-distortionary" objective was given a relatively low weighting.

    c. The **pure AVR royalty options are simple to administer**, but they take no account of the profitability of different mining operations. While pure AVR royalties provide a guaranteed minimum return to the Crown, they provide little upside to the Crown in the case of highly profitable developments. The AVR options therefore performed relatively poorly against both the "fair financial return" and "appropriate risk-sharing" objectives.

35. The Ministry considers the "fair financial return" objective to be far more important than the other objectives. This is an explicit element in a purpose statement that would be added to the Crown Minerals Act 1991 under proposed amendments.[12] This has led to the Ministry favouring a hybrid of a low ad-valorem royalty, which ensures that the Crown (for the benefit of New Zealand) always receives some return from the mining of its minerals, and an accounting profits royalty, so that the Crown shares in the benefits if a mining development proves to be particularly profitable.

36. The modelling work undertaken shows that:

    a. the proposed royalty rates would be internationally competitive

    b. geological prospectivity, commodity prices, exchange rates and development costs are far more material to the project economics of mining than royalty rates at the proposed levels

    c. the proposed royalty rates will have a negligible impact on future mine developments

[12] See the Crown Minerals (Permitting and Crown Land) Bill (introduced 20 September 2012), clause 6.

Table 1: Recommended royalty rates

	Current regime			Proposed royalty regime		
Mineral	**Royalty type**	**Rates**	**Thresholds**	**Royalty type**	**Rates**	**Thresholds**
Coal	Unit-based (per tonne)	$1.40 hard and semi-hard coking $0.80 thermal and semi-soft coking $0.30 lignite	-	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	APR applies to accounting profit >$5m
Underground coal gasification	Ministerial discretion		-	Hybrid AVR/APR	Higher of • 1% AVR • 10% APR	-
Gold and silver	Tiered AVR	1% or 2% AVR	2% AVR applies to annual net sales revenue >$1.5m	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	APR applies to accounting profit >$2m
Platinum group elements	Tiered AVR	1% or 2% AVR	2% AVR applies to annual net sales revenue >$1.5m	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	-
Ironsands	Ministerial discretion		-	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	-
Phosphates	Ministerial discretion		-	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	-
Seafloor massive sulphides	Ministerial discretion		-	Hybrid AVR/APR	Higher of • 2% AVR • 10% APR	-

Making a submission

37. You are invited to make a written submission on the recommendations presented in this discussion paper.

38. The closing date for submissions is **5.00pm, 7 December 2012**.

39. Questions are listed below. We welcome your comments to some or all of the questions raised, as well as broader comment on minerals royalties.

40. Decisions made on Tier 1 royalties will be considered along with the proposed changes to the Crown Minerals Act, and are expected to be in place in 2013.

Sending your submission

41. Please email your submission to mineralroyalties@med.govt.nz. Email is the preferred option.

42. Submissions may also be sent to:

Review of the Royalty Regime for Minerals
Infrastructure & Resource Markets branch
Ministry of Business, Innovation and Employment
PO Box 1473
Wellington 6140
New Zealand
Delivery address: 33 Bowen Street, Wellington 6011
Fax: +64 4 473 7010

43. If you post or fax your submission, please also send it electronically if possible (as a PDF or Microsoft Word document).

Publication of submissions

44. Written submissions may be published at www.med.govt.nz. By making a submission you will be taken to have consented to your submission being published, unless you clearly state otherwise in your submission. If sensitive material in your submission cannot be published, please provide two versions of your submission – a full version and a publishable version.

45. Please clearly indicate in your submission if you do not wish your name to be included in any summary submissions that the Ministry may publish.

46. In any case, all information provided to the Ministry is subject to public release under the Official Information Act 1982. Please inform us if you object to the Ministry releasing any information contained in your submission, and in particular, which parts you consider should be withheld, together with the reasons for withholding the information. We will take your objections into account when we respond to any relevant requests under the Official Information Act 1982 for copies of or information about submissions to this discussion paper.

47. The Privacy Act 1993 establishes certain principles concerning the collection, use and disclosure of information about individuals by various agencies, including the Ministry. It also governs access by individuals to information about themselves held by agencies. In accordance with those privacy principles, any personal information you supply in the course of making a submission will be used by the Ministry only in connection with the matters covered by this discussion paper.

Questions for your feedback

Q1. Do you agree or disagree with the methods and assumptions used by the Ministry to assess royaties for each of the minerals below? Please give reasons for your answer. Feel free to answer for all of the mimerals listed, or for only one or some of them:

a. Coal?

b. Gold and silver?

c. Platinum group elements?

d. Ironsands?

e. Phosphates?

f. Seafloor massive sulphides?

Q2. Do you agree or disagree that the new royalty rate proposed by the Ministry is fair, neutral and non-distortionary, provides appropriate risk-sharing between the private investor and the Crown, and is administratively simple? Please give reasons for your answer. Feel free to answer for all of the minerals listed, or for only one or some of them:

a. Coal?

b. Gold and silver?

c. Platinum group elements?

d. Ironsands?

e. Phosphates?

f. Seafloor massive sulphides?

Q3. Do the proposed changes to royalty rates pose any administrative challenges that the Ministry should know about?

Appendix 1: Review of tax rules for "specified minerals"

48. Inland Revenue has proposed new tax rules for the minerals described in the Income Tax Act 2007 as "specified minerals". This set of minerals, listed in section CU28(1) of that Act includes gold, silver, ironsands, phosphates, platinum group elements, and the minerals that comprise seafloor massive sulphides (principally gold, silver, copper and zinc). "Specified minerals" therefore include all those minerals that are subject to this royalty review, except coal.

49. The current tax rules for these "specified minerals" stand apart from the general tax rules, and have remained largely unchanged since they were introduced in the early 1970s. The current rules are concessionary, allowing specified mineral miners to make deductions for expenditure that would ordinarily be capitalised and depreciated.

50. On 11 July 2011, Cabinet agreed that the tax treatment of the "specified minerals" should be reviewed and that the review should consider more orthodox approaches to taxing this sector. As a result of that review, Inland Revenue has proposed the following new rules.

The proposed new tax rules for specified minerals

51. The proposed new tax rules for "specified minerals" can be divided into those that retain the status quo, those that making mining more economic for miners, and those that reduce concessions for miners.

Status quo

52. Immediate deductions would continue to be allowed for capital expenditure on prospecting, exploration and land restoration.

53. Proceeds from the sale of assets would continue to be taxable in the year in which they were sold.

Proposals that make mining more economic for miners

54. Rehabilitation expenditure would continue to be deductible in the year in which it is incurred. However, consistent with the tax rules that apply outside the mining sector, a deduction would be allowed for payments made to Inland Revenue for expected rehabilitation expenditure. These payments will be held on account for the mining company, which would be able to draw down on them when these liabilities fall due.

55. Currently miners can only claim a deduction on rehabilitation expenditure once it has been incurred. This is often towards the end of a mine's life, when there is little or no income against which to offset this deduction.

Proposals that reduce concessions for miners

56. Normal depreciation rules would apply to expenditure on assets (excluding land) with a useful life independent of the life of the mine - for example, vehicles, portable buildings, vessels and aircraft, and plant and equipment. At present, operators can claim an immediate deduction for these expenses.

57. Expenditure relating to exploration would continue to be deductible as it is incurred. However, once a mine becomes operational, exploration expenditure on items used for the extraction of minerals would be clawed back and would be deducted on a units-of-production basis over the life of the mine. This is broadly consistent with the tax rules for petroleum producers.

58. Expenditure relating to development of mining operations would be capitalised and then amortised on a units-of-production basis over the life of the mine. At present, companies can claim an immediate deduction for development expenditure as it is incurred.

59. Currently, mining companies can claim a deduction for an amount set aside ("appropriated") for mining exploration or mining development if the amount will be applied for these purposes within the next two years. This deduction will no longer be available.

60. The costs of land would be held on revenue account, with the losses and income taxable on a realised basis for land acquired for mineral mining. At present, these costs can be deducted as soon as they are incurred.

Appendix 2: Coal modelling

Scenarios modelled for coal

61. The Ministry modelled four representative coal mines:

    a. **Scenario 1**: a one million tonne per annum HCC opencast mine

    b. **Scenario 2**: a 100,000 tonne per annum sub-bituminous opencast mine

    c. **Scenario 3**: a 300,000 tonne per annum high coking underground mine

    d. **Scenario 4**: a 100,000 tonne per annum lignite opencast mine

62. A summary of all assumptions used for each scenario is provided in Table 2. The key assumptions are as follows:

    a. **Strip ratio**:[13] The Ministry has used a strip ratio of 9:1 for scenarios 1 and 2. The Ministry notes that some of New Zealand's largest coal mines have a strip ratio of less than 7:1 and it considers a 9:1 ratio a sufficiently conservative assumption to be used for opencast mining. For scenario 4 (100,000 tonne lignite opencast development) a strip ratio of 2.5:1 has been used.

    b. **Capital costs**:

        i. NZ$80 million for scenario 1

        ii. NZ$10 million for scenario 2

        iii. NZ$95 million for scenario 3

        iv. NZ$10 million for scenario 4.

    c. **Sustaining capital**: Based on industry feedback, the Ministry has used NZ$5 per tonne for scenarios 1, 2 and 4 and NZ$10 per tonne for scenario 3.

    d. **Other costs (administration plus overhead)**: The Ministry has used NZ$5 per tonne for scenarios 1 and 4, and $10 per tonne for scenarios 2 and 3, based on feedback from industry.

    e. **Rehabilitation**: The Ministry has made estimates based on the assumption that rehabilitation costs equate to NZ$2 per tonne for a strip ratio of 2.5:1. For underground mines, where the land footprint and rehabilitation costs are considerably less than for opencast mines, the Ministry has assumed that rehabilitation costs are one seventh of opencast costs (that is, between one fifth and one tenth of opencast costs).

[13] The strip ratio is the ratio of the volume of overburden (or waste material) required to be handled in order to extract some volume of ore.

f. **Mine life**. The Ministry has assumed a 20-year mine life.

g. **Land access fees**: The Ministry has modelled land access fees of two percent of revenues for opencast mines and 0.3 percent for underground mines (that is, approximately one seventh the land access fees of opencast mines).

Table 2: Coal assumptions

Input	Range or value
Scenario 1	One million tonne pa plateau production. HCC opencast mine. Eight year ramp up. 20-year mine life.
Scenario 2	100,000 tonne pa sub-bituminous opencast. 20-year mine life.
Scenario 3	300,000 tonne pa HCC underground. 20-year mine life.
Scenario 4	100,000 tonne pa lignite opencast. 20-year mine life.
Exchange rate (US$/NZ$)	0.65
Strip ratio - opencast (bcm per tonne)	9 (scenarios 1 and 2), 2.5 (scenario 4)
Development ratio - underground	20
Benchmark price (NZ$/tonne)	
- HCC	236.92
- Thermal	142
- Lignite	62
Freight costs (NZ/tonne)	35 (scenario 1), 10 (scenario 2), 15 (scenario 3), 5 (scenario 4)
Extraction cost (NZ$/tonne)	3.6 (scenario 1), 3.6 (scenario 2), 2,100 (scenario 3), 4.0 (scenario 4)
Processing cost (NZ$/tonne)	12.3 (scenario 1), 12 (scenario 2), 40 (scenario 3), 7 (scenario 4)
Emissions factor	0.0008 (scenario 1), 0.0008 (scenario 2), 0.018 (scenario 3), 0.008 (scenario 4)
Up-front capital costs (NZ$ million)	80 (scenario 1), 10 (scenario 2), 95 (scenario 3), 10 (scenario 4)
Sustaining capital (NZ$/tonne)	5 (scenario 1), 5 (scenario 2), 10 (scenario 3), 5 (scenario 4)
Depreciation average over all mines	20 years
Other capex diminishing value (all mines)	15%
Corporate overhead (NZ$/tonne)	5 (scenario 1), 10 (scenario 2), 10 (scenario 3), 5 (scenario 4)
Decommissioning/rehabilitation costs (NZ$ million)	49.15 (scenario 1), 5 (scenario 2), 0.34 (scenario 3), 1.27 (scenario 4)
Operating and capital overhead allowance	0%
Discount rate	10%
Inflation	3%
Energy Resources Levy (NZ$/tonne)	2 (scenarios 1 and 2), 1.5 (scenario 4)

Table 3: Probability distributions used for coal modelling

Scenario 1: One million tonne pa coking	Distribution applied	Mean	Standard deviation
Price - US$/tonne	Normal	236.9	47.4
Production opencast (tonnes pa)	Normal	1	0.2
Strip ratio opencast (bcm per tonne)	Normal	9	3.1
Extraction opencast (NZ$ per bcm)	Normal	3.6	0.9
Processing opencast (NZ$ per tonne)	Normal	12.3	2.3
Up-front capital opencast (NZ$)	Normal	80,000,000	16,000,000
Sustaining capital opencast (NZ$ per tonne)	Normal	5	0.8
Scenario 2: 100,000 tonne pa sub-bituminous			
Price - US$/tonne	Normal	142.0	28.4
Production opencast (tonnes pa)	Normal	1	0.2
Strip ratio opencast (bcm per tonne)	Normal	9	3.1
Extraction opencast (NZ$ per bcm)	Normal	3.6	0.9
Processing opencast (NZ$ per tonne)	Log normal	12	2
Up-front capital opencast (NZ$)	Normal	10,000,000	2,000,000
Sustaining capital opencast (NZ$ per tonne)	Normal	5	0.8
Scenario 3: 300,000 tonne pa coking underground			
Price - US$/tonne	Normal	236.9	47.4
Production underground (tonnes pa)	Normal	1	0.2
Development ratio underground (tonne per metre)	Normal	20	5.7
Extraction underground (NZ$ per bcm)	Normal	2,100	384.6
Processing underground (NZ$ per tonne)	Log normal	40	10
Up-front capital opencast (NZ$)	Normal	95,000,000	31,666,667
Sustaining capital underground (NZ$ per tonne)	Normal	10	3.3
Scenario 4: 100,000 tonne pa lignite			
Price - US$/tonne	Normal	62	12.4
Production opencast (tonnes pa)	Normal	1	0.2
Strip ratio opencast (bcm per tonne)	Normal	2.5	0.4
Extraction opencast (NZ$ per bcm)	Normal	4	1
Processing opencast (NZ$ per tonne)	Log normal	7	2
Up-front capital opencast (NZ$)	Normal	10,000,000	2,000,000
Sustaining capital opencast (NZ$ per tonne)	Normal	5	0.8

Analysis of options: Coal

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

63. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the pure APR option, it would take three years of production before royalty payments would begin in scenario 3, five years in scenarios 1 and 2, and six years in scenario 4.

Internationally competitive

64. Converting an AVR royalty to an equivalent APR royalty results in significantly different outcomes depending on the mine scenario. In the case of the four mine developments modelled for New Zealand, a 10 percent APR equates to between a 0.9 percent AVR and a 3.2 percent AVR, depending on the scenario. The Ministry has used a three percent AVR as a reasonable approximation for a 10 percent APR. This has then been used to work out the approximate Crown share in a number of international jurisdictions[14]. In the case of Australia, the Ministry has relied on KPMG Australia's analysis of total Crown share for coal. Although there are a number of limitations with this approach, nevertheless the Ministry maintains that it provides a reasonable benchmark against which New Zealand's royalty rate options can be compared.

65. The results are set out in Table 4 below. They show that all of the royalty options reviewed are more competitive than those in other jurisdictions.

[14] So for a country with a four percent AVR and a corporate tax rate of 30 percent the calculation would be as follows: (0.1 / 3 * 4) + ((1 - (0.1 / 3 * 4)) * 0.3) = 37 percent.

Table 4: Comparison of Crown share by regime (Coal)

	Royalty method	Royalty rate	Tax rate	Indicative Crown take
New Zealand - status quo	Unit-based	$1.4 per tonne	28%	29.8%
New Zealand - AVR 1	AVR	1%	28%	31.6%
New Zealand - AVR 2	AVR	2%	28%	35.2%
New Zealand - pure APR	APR	10%	28%	35.2%
New Zealand - Hybrid 1	Hybrid AVR / 10% APR		28%	35.6%
New Zealand - Hybrid 2	Hybrid AVR / 10% APR		28%	36.3%
Canada - Alberta	APR	13%	28%	37.4%
Russia	AVR	4%	28%	37.6%
Canada - Ontario	APR	max 17%	27%	39.4%
Australia*	Varies by State	Varies by State	30%	45.8%
South Africa	AVR	max 7%	33%	48.6%
Colombia	AVR	10%	33%	55.3%
Indonesia	AVR	13.50%	28%	60.4%

**KPMG Australia analysis. Note that state royalties are fully deductible against the Minerals Resource Rent Tax. 45.8% is the maximum Crown take.*

Upside to the Crown

66. Table 5 below shows the impact of various royalty regimes for each mine scenario. Scenario 1 is profitable in over 87 percent of the iterations modelled before a royalty is applied. The internal rate of return is over 26 percent under each royalty option. As this is a large profitable development, the $5 million profitability threshold is attained and this mine would pay the APR component under either the APR, Hybrid 1 or Hybrid 2 options, each of which offers a significantly higher financial return than either of the AVR options or the status quo.

67. The other three mine development scenarios are marginal. The $5 million threshold would not be met in either scenario 2 (sub-bituminous) or scenario 3 (lignite). The threshold would be met for scenario 3 (underground mine) using base-case assumptions, with the mine paying the higher APR rate from the sixth year of production.

Table 5: Royalty take (NZ$ million) for future mine developments (Coal)

	One million tonne pa HCC opencast			100,000 tonne pa sub-bituminous opencast		
	P90	P50	P10	P90	P50	P10
Status quo	10.0	10.0	10.0	0.8	0.8	0.8
1% AVR	8.3	12.5	17.3	0.8	1.1	1.6
2% AVR	16.7	25.1	34.7	1.5	2.3	3.1
10% APR	3.5	40.2	85.3	0.0	0.8	5.1
Hybrid 1%AVR/10% APR	9.8	43.0	86.8	0.8	1.1	5.1
Hybrid 2%AVR/10% APR	17.0	45.7	88.3	1.5	2.3	5.4
1% AVR versus status quo	-1.7	2.5	7.3	-0.0	0.3	0.8
2% AVR versus status quo	6.7	15.1	24.6	0.7	1.5	2.4
10% APR versus status quo	-6.5	30.2	75.3	-0.8	0.1	4.3
Hybrid 1%AVR/10%APR versus status quo	-0.2	32.9	76.8	-0.0	0.3	4.4
Hybrid 2%AVR/10%APR versus status quo	7.0	35.7	78.3	0.7	1.5	4.6

	300,000 tonne pa HCC underground			100,000 tonne pa lignite opencast		
	P90	P50	P10	P90	P50	P10
Status quo	4.2	4.2	4.2	0.3	0.3	0.3
1% AVR	4.1	6.0	7.9	0.3	0.5	0.7
2% AVR	8.2	11.9	15.8	0.7	1.0	1.3
10% APR	0.0	8.8	28.4	0.0	0.6	2.0
Hybrid 1%AVR/10% APR	4.3	10.9	29.2	0.3	0.5	0.7
Hybrid 2%AVR/10% APR	8.1	13.9	30.1	0.7	1.0	1.3
1% AVR versus status quo	-0.1	1.8	3.7	0.0	0.2	0.4
2% AVR versus status quo	4.0	7.8	11.6	0.4	0.7	1.0
10% APR versus status quo	-4.2	4.6	24.2	-0.3	0.4	1.7
Hybrid 1%AVR/10%APR versus status quo	0.1	6.7	25.0	0.0	0.2	0.4
Hybrid 2%AVR/10%APR versus status quo	4.0	9.7	25.9	0.4	0.7	1.0

68. Based on this modelling work, the Hybrid 2 option provides the Crown with the highest returns across the range of mine development scenarios and probabilities. Hybrid 1 ranks second, the pure APR third, AVR 2 fourth, and AVR 1 fifth.

Objective 2: Neutral / non-distortionary

69. Royalty regimes have been assessed against the "neutral / non-distortionary" objective by assessing the extent to which they have the effect that developments that are economic before a royalty is applied become uneconomic after the application of a royalty.

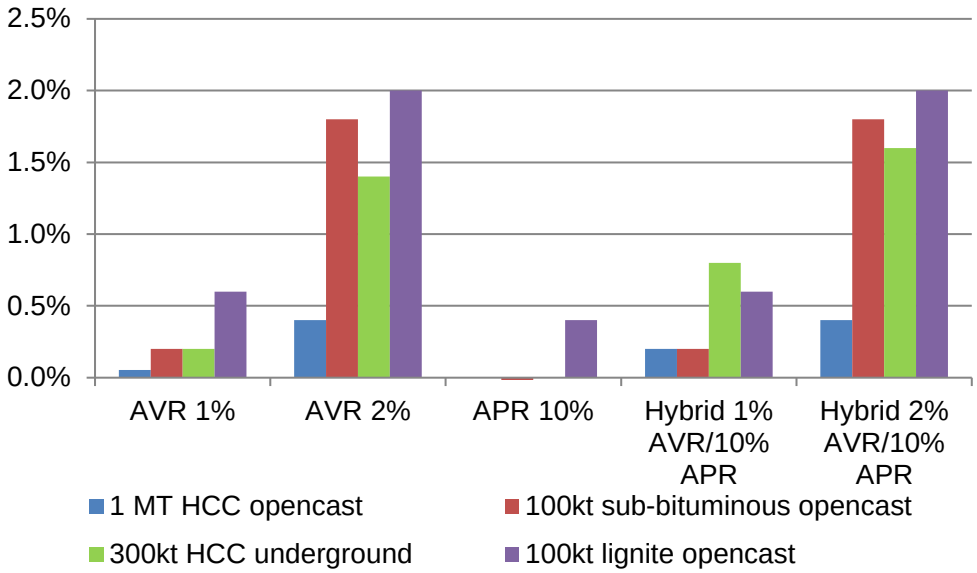
70. One method of testing this is to assess a proposed royalty regime's impact on commercial success rates against the current regime. Figure 2 highlights the difference in commercial success rates compared to the status quo, assuming the hurdle rate of a 10 percent IRR to the company. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to a regime with no royalties.

71. The results reflect the underlying economics of the mine project. For highly profitable mines like the one million tonne per annum HCC opencast development (scenario 1), any of the royalty options proposed would result in up to two fewer commercial developments over the 500 iterations modelled, depending on the royalty option, compared to the status quo.

72. Even for more marginal developments, the royalty options reviewed have a relatively modest impact on commercial developments. This highlights the importance of other factors (for example, development costs, strip ratio, and commodity prices) to the mine's project economics compared with royalty rates.

73. The results also highlight the regressive nature of AVR royalties versus profits-based royalties. The imposition of a pure APR tends to result in slightly more commercial discoveries than with AVR or hybrid AVR/APR royalties.

Figure 2: Reduction in commercial success rate relative to status quo (Coal)



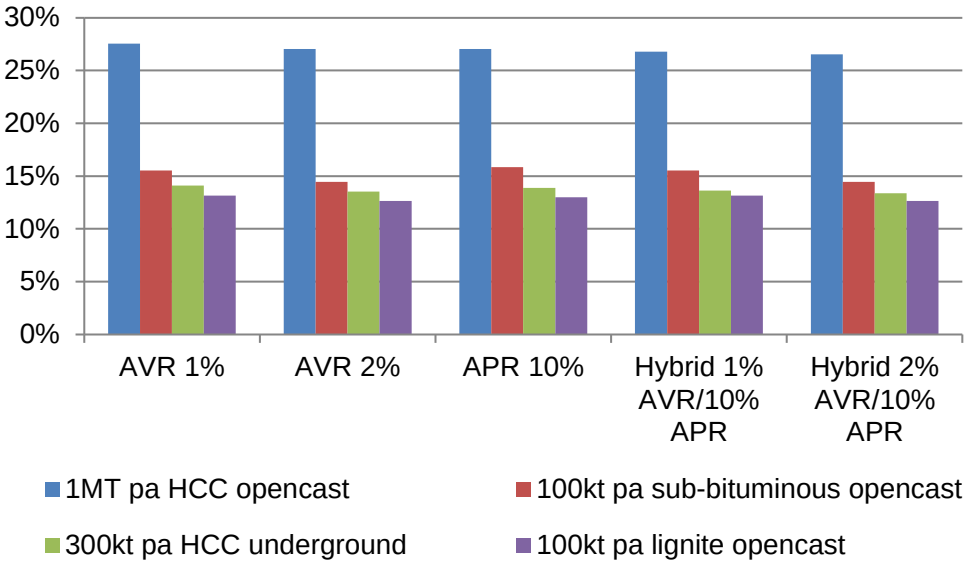
74. Assessed against the "neutral / non-distortionary" objective, the pure APR performs best, followed by AVR 1 and Hybrid 1, and then AVR 2 and Hybrid 2. However, given the importance of the underlying economics of the mine developments, the differences between royalty options are relatively small. Accordingly, the Ministry has placed little weight on this objective.

Objective 3: Appropriate risk-sharing between private investment and the Crown

75. To assess royalty options against this objective, the Ministry has measured the extent to which each option improves returns to companies for marginal mine developments while improving returns to the Crown in highly profitable developments.

76. Under the base-case assumptions, each mine would be developed, although the 100,000 tonne per annum sub-bituminous opencast mine, the 300,000 tonne per annum HCC underground mine and the lignite development are marginal under some or all of the royalty options reviewed (that is, the IRR to the operator is between 10 percent and 15 percent).

Figure 3: Internal rates of return to operator (Coal)



77. The marginal nature of the three smaller mines is further highlighted in the Monte Carlo simulations. Of the 500 model iterations undertaken for each mine development, over 37 percent of cases would be uneconomic for the three smaller mines, even before a royalty has been applied (see Figure 4 below).

Figure 4: Probability of unsuccessful mine development with no royalty (Coal)

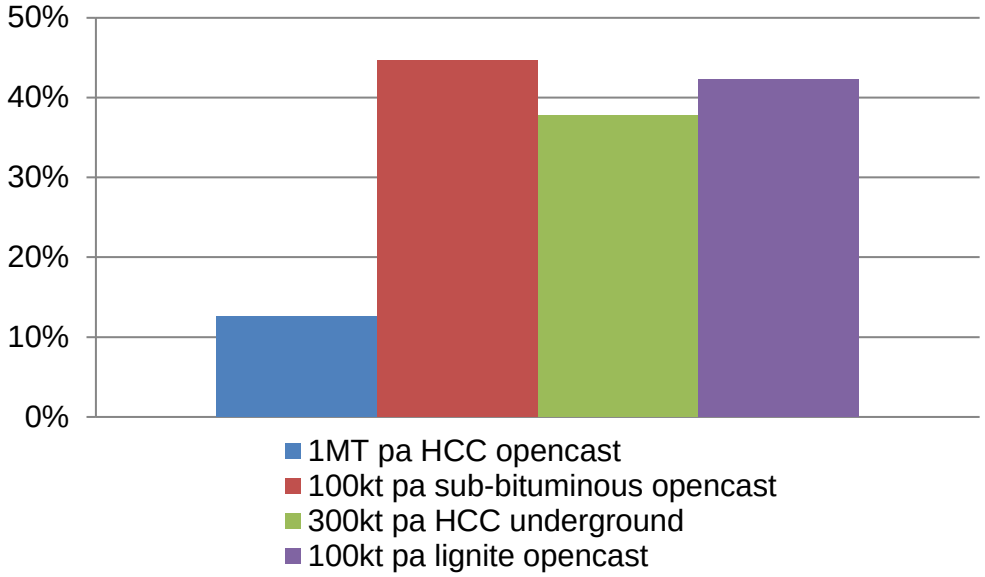


Table 6: Net present value to operator (NZ$ million) for future mine developments (Coal)

	One million tonne pa HCC opencast			100,000 tonne pa sub-bituminous opencast		
	P90	**P50**	**P10**	**P90**	**P50**	**P10**
Status quo	-47.8	262.3	590.7	-28.6	3.1	35.3
1% AVR	-47.8	260.4	585.3	-28.7	2.8	34.8
2% AVR	-54.2	250.9	573.0	-29.5	2.0	33.7
10% APR	-44.9	239.8	536.7	-27.8	3.0	32.2
Hybrid 1%AVR/10% APR	-49.2	237.8	535.6	-28.7	2.8	32.2
Hybrid 2%AVR/10% APR	-53.6	235.9	534.4	-29.5	2.0	32.0
1% AVR versus status quo	-0.1	-1.8	-5.4	-0.1	-0.3	-0.5
2% AVR versus status quo	-6.4	-11.4	-17.7	-1.0	-1.1	-1.6
10% APR versus status quo	2.9	-22.4	-54.0	0.7	-0.1	-3.1
Hybrid 1%AVR/10%APR versus status quo	-1.4	-24.5	-55.1	-0.1	-0.3	-3.1
Hybrid 2%AVR/10%APR versus status quo	-5.8	-26.4	-56.2	-1.0	-1.1	-3.3

	300,000 tonne pa HCC underground			100,000 tonne pa lignite opencast		
	P90	P50	P10	P90	P50	P10
Status quo	-167.1	32.0	177.3	-9.7	1.6	12.3
1% AVR	-167.5	31.1	175.1	-9.7	1.5	12.1
2% AVR	-172.8	27.1	169.9	-10.1	1.1	11.6
10% APR	-161.9	29.0	160.9	-9.3	1.4	11.1
Hybrid 1%AVR/10% APR	-167.5	27.4	160.1	-9.7	1.5	12.1
Hybrid 2%AVR/10% APR	-172.8	26.0	159.1	-10.1	1.1	11.6
1% AVR versus status quo	-0.4	-0.9	-2.1	-0.1	-0.1	-0.3
2% AVR versus status quo	-5.7	-4.9	-7.4	-0.5	-0.5	-0.7
10% APR versus status quo	5.1	-3.0	-16.3	0.3	-0.3	-1.2
Hybrid 1%AVR/10%APR versus status quo	-0.4	-4.6	-17.1	-0.1	-0.1	-0.3
Hybrid 2%AVR/10%APR versus status quo	-5.7	-6.0	-18.2	-0.5	-0.5	-0.7

78. Table 6 above shows that the pure APR option provides a modest upside to the miner in each P90 mine development scenario, and a substantial upside to the Crown in each P10 scenario. The AVR royalty options provide either little or no benefit to the miner in the P90 scenario and very little upside to the Crown in the P10 scenarios. The hybrid options show little or no upside to the miner in the P90 scenarios but substantial upside to the Crown in the P10 scenarios.

79. Based on those results, the pure APR option has been ranked the best option against the "appropriate risk-sharing" objective, with Hybrid 1 second, Hybrid 2 third, AVR 1 fourth, and AVR 2 fifth.

Objective 4: Be simple to administer for both the Crown and industry

80. AVR options are simpler to administer than pure APR or hybrid options.

Recommendation: Coal

81. The Ministry recommends a two percent AVR with a 10 percent APR applying to mine developments with annual accounting profits of more than $5 million. It recommends retaining the existing threshold of royalties only being payable when the royalty calculated as payable is more than $2,000 for a calendar year.

82. The Ministry considers that this royalty option will provide the highest returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and will have a negligible impact on the number of companies that decide to proceed with a mine development.

83. The Ministry has not been able to model UCG mine developments, but it notes comments made by industry to KPMG that the business model for UCG is sufficiently different from coal mining to require separate analysis and also potentially a separate royalty. In the absence of any reliable information, the Ministry proposes a hybrid royalty for UCG of the higher of a one percent AVR and a 10 percent APR.

Appendix 3: Gold and silver modelling

Scenarios modelled for gold

84. The Ministry modelled three representative mines:

a. **Base scenario, opencast**: a large hard rock opencast mine producing 72,580 ounces of gold per annum from one million tonnes of ore. The mine would produce at the plateau production for 14 years before declining each year to year 20 of the mine life. The input assumptions have been based on a pure greenfield development, rather than current exploration activities that, if they were to prove successful, could tie back into existing mining operations. The development costs are therefore significant and would require a high gold grade in order for the mine to be economic. The gold grade of 4 grams per tonne is higher than existing mining operations but is what would be needed to make economic a development scenario with the development and extraction costs provided in this case.

b. **Underground scenario**: a large underground mine producing close to 122,000 ounces of gold per annum from 700,000 tonnes of ore. The mine would produce at the plateau production for 18 years before production began declining through to year 20 of the mine life.

c. **Alluvial scenario**: a large alluvial gold mine producing close to 4,000 ounces of gold from 250,000 tonnes of ore. Production is assumed to be constant for 26 years. Typically alluvial mining permits last for no more than 10 years. This scenario assumes that the miner is able to mine neighbouring areas to feed in to production facilities at a single site.

Table 7: Gold assumptions

Input	Range or value
Base	1.0 million tonne pa opencast
Underground	700K tonne pa underground
Alluvial	250K tonne pa alluvial
Strip ratio (ratio of waste to usable ore)	
- Opencast	4
- Underground	0.4
- Alluvial	0.8
Maximum concentration - gold (grams/tonne ore)	2.5 (opencast) 6 (underground) 0.4 (alluvial)
Recovery - gold (% of gold recovered from ore)	90% (open pit), 90% (underground), 98% (alluvial)
Maximum concentration - silver (grams/tonne ore)	19 (opencast) 14 (underground)
Recovery - silver (% of silver recovered from ore)	70%
International benchmark price (US$/troy ounce)	
- Gold	1,500
- Silver	20
Discount for unmilled gold	90%
Extraction cost (NZ$/tonne)	
- Opencast	20
- Underground	54
- Alluvial	1.5
Fixed opex costs (extraction) (NZ$ million)	
- Opencast	2
- Underground	9
- Alluvial	0.75
Processing costs (NZ$/tonne)	
- Opencast	17
- Underground	25
Fixed opex costs (processing) (NZ$)	
Up-front exploration costs (one-off cost prior to production year 1) (NZ$ million)	
- Opencast	10
- Underground	15
- Alluvial	1

Input	Range or value
Ongoing exploration costs (NZ$ million/year)	
- Opencast	2
- Underground	4
- Alluvial	0.2
Mine development costs (NZ$ million)	
- Opencast	175
- Underground	250
- Alluvial	0.4
Ongoing development costs (NZ$ million/year)	1%
Other capex (NZ$ million)	
- Opencast	0.5
- Underground	0.75
- Alluvial	0.075
Depreciation average	20
Other capex diminishing value	15%
Indirect costs	1%
Decommissioning costs	10%
Operating and capital overhead allowance	1%
Inflation	
- Commodity price	3%
- Opex	3%
Discount rate	10%
Exchange rate	0.65
Land access fees	$23.4 million (open pit), $3 million (underground), 5% of revenues (alluvial)

Table 8: Probability distributions used in gold modelling

Base scenario: one million tonne per annum opencast			
	Distribution applied	**Mean**	**Standard deviation**
Strip ratio (bcm per tonne)	Normal	4	0.12
Concentration (Au g/t)	Normal	4	0.78
Price (% of forecast)	Normal	1	0.16
Open pit extraction cost (NZ$ per tonne)	Normal	20	0.78
Production volumes (% of forecast)	Normal	1	0.39
Exchange rate	Normal	0.65	0.08
Underground scenario: 700,000 tonne pa			
Strip ratio (bcm per tonne)	Normal	0.4	0
Concentration (Au g/t)	Normal	6	1
Recovery	Normal	0.9	0.05
Price (% of forecast)	Normal	1	0.16
Underground extraction cost (NZ$ per tonne)	Normal	54	4.21
Production volumes (% of forecast)	Normal	1	0.16
Exchange rate	Normal	0.65	0.08
Alluvial scenario: 250,000 tonne pa			
Strip ratio (bcm per tonne)	Normal	3	0.78
Concentration (Au g/t)	Normal	0.5	0.78
Price (% of forecast)	Normal	1	0.16
Extraction cost (NZ$ per tonne)	Normal	1.5	0.39
Exploration costs (NZ$)	Normal	1,000,000	780,304
Exchange rate	Normal	0.65	0.08

Analysis of options: Gold and silver

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

85. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the 10 percent APR option, it would take three years of production before royalty payments would begin in the base opencast scenario, and four years in the underground scenario.

Internationally competitive

86. Converting an AVR royalty to an equivalent APR royalty results in significantly different outcomes, depending on the mine scenario. In the case of the three mine developments modelled for New Zealand, a 10 percent APR equates to an AVR of between 2.0 and 3.5 percent, depending on the scenario. The Ministry has used a three percent AVR as a reasonable approximation for a 10 percent APR. This has then been used to work out the approximate Crown share in a number of international jurisdictions[15]. Further adjustments have been made for hybrid regimes. The Ministry acknowledges a number of limitations with this approach.

87. The results are set out in Table 9 below. They show that New Zealand currently has the most competitive royalty rate of any of the jurisdictions reviewed, except for the Australian state of Victoria. A 10 percent APR or a hybrid with a 10 percent APR would not change the competitiveness of New Zealand compared with the other jurisdictions reviewed.

[15] So for a country with a three percent AVR and a corporate tax rate of 30 percent, the calculation would be as follows: (0.1 / 4 * 3) + ((1 - (0.1 / 4 *3)) * 0.3) = 35.3 percent.

Table 9: Comparison of Crown share by regime (Gold)

	Royalty method	Royalty rate	Tax rate	Indicative Crown take
Australia - Victoria	AVR	0.0%	30.0%	30.0%
New Zealand (current)	AVR	2.0%	28.0%	32.8%
New Zealand (10% APR or hybrid)	APR or hybrid	10.0%	28.0%	35.2%
Canada - Saskatchewan	APR	10.0%	28.0%	35.2%
China	Unit-based and AVR	4.0%	25.0%	35.3%
Australia - WA	AVR	2.5%	30.0%	35.8%
Brazil	AVR	1.0%	34.0%	36.2%
Australia - Queensland	AVR	2.7%	30.0%	36.3%
Peru	AVR	3.0%	30.0%	37.0%
Canada - BC	APR	13.0%	28.5%	37.8%
Canada - Ontario*	APR	15.0%	27.0%	38.0%
Australia - SA	AVR	3.5%	30.0%	38.2%
India	AVR	2.0%	34.0%	38.4%
USA - Nevada	APR	5.0%	35.0%	38.3%
Australia - NSW	AVR	4.0%	30.0%	39.3%
Argentina	AVR	3.0%	35.0%	41.5%
Australia - Tasmania	Hybrid	5.0%	30.0%	41.7%
Australia - NT	APR	20.0%	30.0%	44.0%
South Africa**	AVR	max 7%	33.0%	48.6%
USA - Arizona	AVR	2.0%	42.0%	45.9%
Botswana	AVR	5.0%	40.0%	50.0%

** Ontario has a tiered APR from 10% to 17% APR, depending on the level of accounting profits. A 15% APR applies to mines with an accounting profit of between C$55 million to C$100 million. This is the range of accounting profits for the opencast and underground gold mines modelled and has been used here.*

*** South Africa applies a corporate tax rate of 33% to foreign-owned South African branches and 28% for local companies.*

Potential Crown revenue versus company return

88. Table 10 below shows the impact of various royalty regimes for the one million tonne per annum hard rock opencast mine (base scenario). This large opencast mine is profitable in over 65 percent of the iterations modelled before a royalty is applied, using a 10 percent discount rate. The internal rate of return (IRR) is over 17 percent across all the royalty options modelled in the median case. As this is a large profitable development, the $2 million profitability threshold is attained and this mine would pay the APR component under either the APR, Hybrid 1 or Hybrid 2 options, each of which offers a significantly higher financial return than either of the AVR options or the status quo.

89. The 700,000 tonne per annum hard rock underground gold mine is profitable in 85 percent of the iterations modelled using a discount rate of 10 percent. The IRR to the operator is over 16 percent under each of the royalty options reviewed. The APR and hybrid options offer the greatest return to the Crown, providing $40 million or more (depending on the royalty option) relative to the AVR 2 option in the median case, while reducing the internal rate of return to the operator by less than one percentage point.

90. The 250,000 tonne per annum alluvial gold mine is highly profitable using the base-case assumptions. The IRR to the operator is more than 43 percent across all the royalty options reviewed. The economics of the mine fluctuate markedly depending on the strip ratio used. In this alluvial mine scenario the pure APR provides the highest return to the Crown. The reason the pure APR is higher than the hybrid options is because the threshold of $2 million accounting profit is never met, and therefore the 10 percent APR is never applied under the hybrid options.

Table 10: Royalty take (NZ$ million) for future mine developments (Gold)

	Opencast gold mine			Underground gold mine			Alluvial gold mine		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo	12.0	43.5	78.5	33.4	48.5	66.0	0.3	0.5	1.0
1% AVR	8.7	22.2	40.0	17.1	24.8	33.8	0.3	0.4	0.6
2% AVR	17.4	44.4	80.1	34.2	49.7	67.6	0.6	0.9	1.1
10% APR	0.0	48.6	168.8	27.6	83.6	158.5	0.0	0.8	1.8
Hybrid 1%AVR/10% APR	8.9	55.1	174.1	36.8	90.9	165.2	0.3	0.4	0.6
Hybrid 2%AVR/10% APR	17.8	61.9	179.4	45.4	97.9	171.8	0.6	0.9	1.1
1% AVR versus status quo	-3.3	-21.3	-38.5	-16.3	-23.7	-32.2	-0.0	-0.0	-0.4
2% AVR versus status quo	5.4	0.9	1.6	0.8	1.2	1.6	0.3	0.4	0.1
10% APR versus status quo	-12.0	5.1	90.3	-5.7	35.1	92.5	-0.3	0.3	0.8
Hybrid 1%AVR/10%APR versus status quo	-3.1	11.5	95.6	3.4	42.3	99.2	-0.0	-0.0	-0.4
Hybrid 2%AVR/10%APR versus status quo	5.8	18.4	100.9	12.0	49.4	105.8	0.3	0.4	0.2

91. Based on the results shown above, Hybrid 2 has been ranked best, Hybrid 1 second, AVR 2 third, the pure APR fourth, and AVR 1 fifth. The reason for ranking AVR 2 above the pure APR is that is provides a guaranteed minimum return to the Crown at the outset of production.

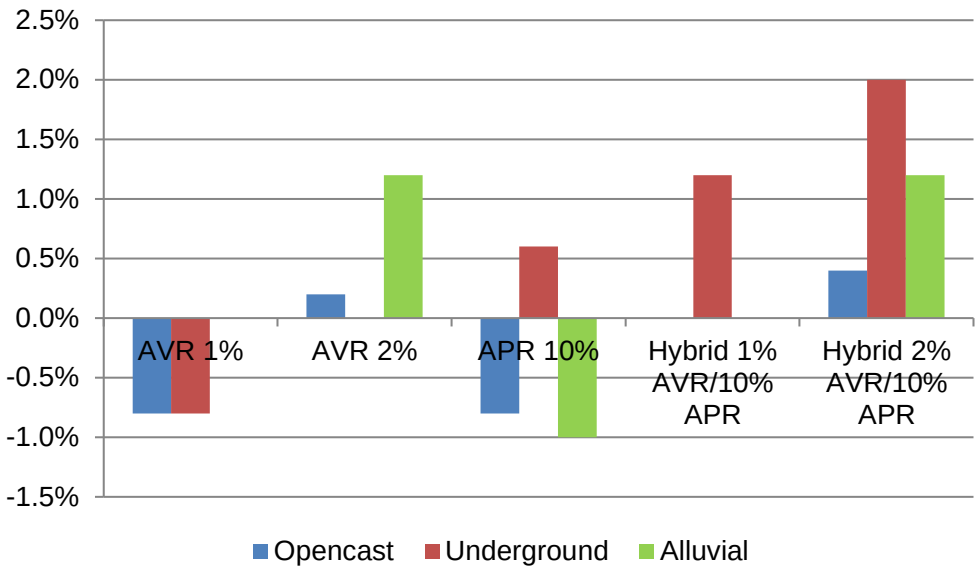
Objective 2: Neutral / non-distortionary

92. Royalty regimes have been assessed against this objective by assessing the extent to which they have the effect that developments that are economic before a royalty is applied become uneconomic after the application of a royalty.

93. This has been tested in the same manner as for the model coal mines. Figure 5 below highlights the difference in commercial success rates compared to the current royalty regime, assuming a company hurdle rate of 10 percent IRR. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to a regime with no royalties. If the alternative regime is below zero, then it represents more commercial successes relative to the status quo.

94. Just as for coal, the results for the model gold mines reflect the underlying economics of each mine project, with fewer than two percent of the 500 model iterations affected in any of the mine development scenarios.

Figure 5: Reduction in commercial success rate relative to status quo (Gold)



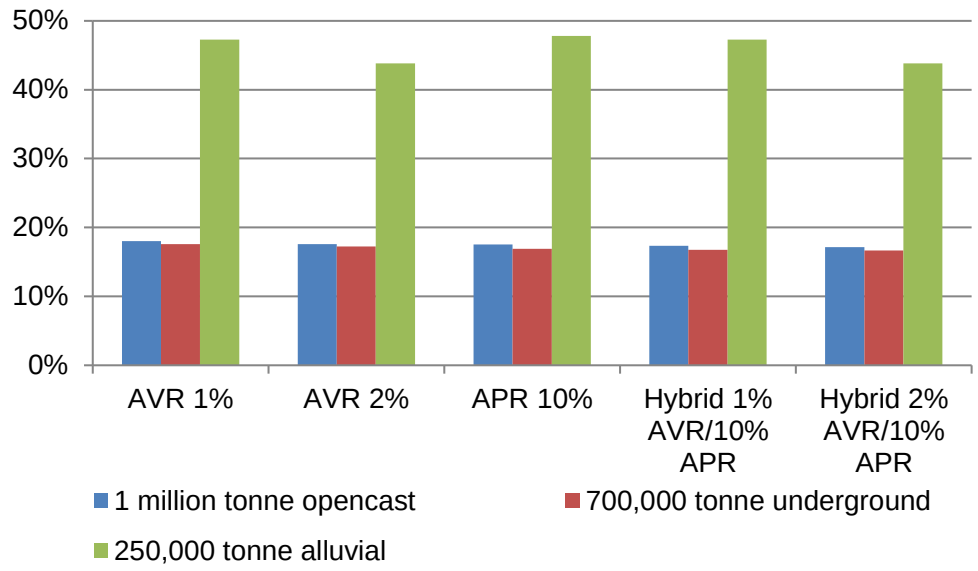
95. On this basis, the AVR 1 option performs best overall, the pure APR second, Hybrid 1 third, AVR 2 fourth, and Hybrid 2 fifth. However, given the relatively small number of potential mines affected (13 fewer mines out of 500 simulations for the Hybrid 2 relative to the pure APR), this "neutral/non-distortionary" objective should be given relatively little weight overall.

Objective 3: Appropriate risk-sharing between private investment and the Crown

96. Royalty options have been assessed against this objective by measuring the extent to which each option improves returns to companies for marginal P90 mine developments while improving returns to the Crown in highly profitable P10 developments, relative to the status quo.

97. Under the base-case assumptions, each mine would be developed. Each mine provides an internal rate of return to the operator of more than 16 percent, with the alluvial gold development delivering returns of more than 40 percent under the base-case assumptions.

Figure 6: Internal rates of return to operator (Gold)



98. The Monte Carlo simulation highlighted the sensitivities of each mine development pre-application of a royalty. The one million tonne opencast mine would not meet a commercial hurdle rate of 10 percent in 38 percent of the 500 model iterations, while for the alluvial gold development 24 percent of the model iterations would fail to meet the hurdle rate.

Figure 7: Probability of unsuccessful mine development with no royalty (Gold)

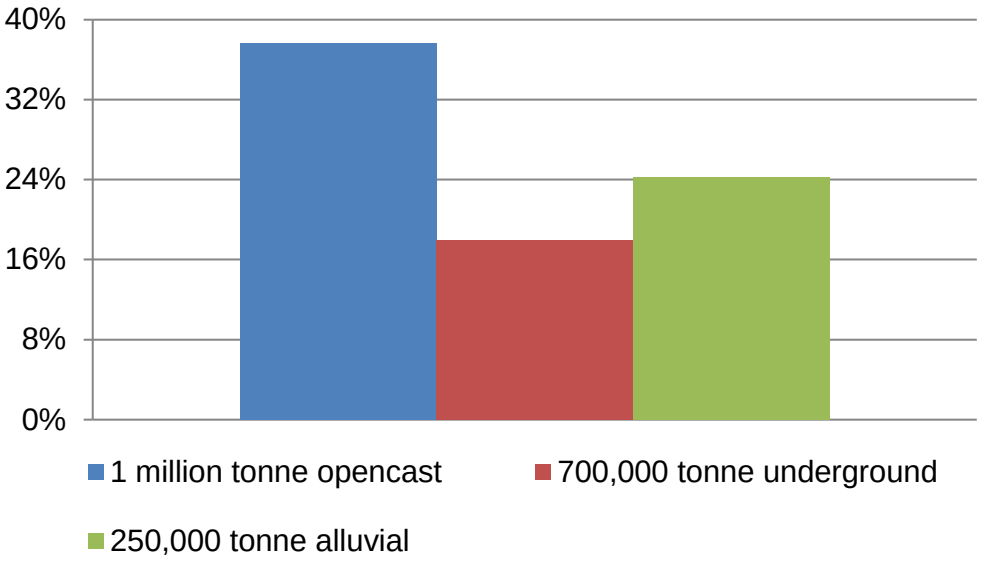


Table 11: Net present value to operator (NZ$ million) for future mine developments (Gold)

	Opencast gold mine			Underground gold mine			Alluvial gold mine		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo	-452.3	175.0	1,041.3	-119.5	312.9	861.6	-5.4	4.7	11.7
1% AVR	-452.3	190.4	1,069.2	-106.6	329.7	884.5	-5.4	4.4	12.0
2% AVR	-461.1	174.3	1,040.1	-120.1	312.1	860.4	-5.7	4.4	11.6
10% APR	-441.8	171.9	976.7	-113.0	287.6	794.6	-5.0	4.7	11.1
Hybrid 1%AVR/10% APR	-452.3	167.4	972.9	-120.5	282.6	789.8	-5.4	4.4	12.0
Hybrid 2%AVR/10% APR	-461.1	162.5	969.0	-128.0	277.6	785.0	-5.7	5.0	11.6
1% AVR versus status quo	0.0	15.3	27.9	12.9	16.8	23.0	0.0	-0.3	0.3
2% AVR versus status quo	-8.8	-0.7	-1.1	-0.6	-0.8	-1.2	-0.4	-0.2	-0.0
10% APR versus status quo	10.5	-3.1	-64.6	6.6	-25.3	-67.0	0.4	0.0	-0.6
Hybrid 1%AVR/10%APR versus status quo	0.0	-7.6	-68.4	-1.0	-30.3	-71.8	0.0	-0.3	0.3
Hybrid 2%AVR/10%APR versus status quo	-8.8	-12.6	-72.2	-8.5	-35.3	-76.6	-0.4	0.3	-0.0

99. Table 11 above shows the respective upside potential to the miner (relative to the status quo) in each of the P90 mine developments and the upside to the Crown across the P10 mine developments. Both the AVR 1 and pure APR options provide some upside to the miner in all P90 scenarios, while the pure APR and hybrid options provide the most upside to the Crown in the P10 scenarios.

100. Assessed against the "appropriate risk-sharing" objective, the pure APR has been ranked best, Hybrid 1 second, Hybrid 2 third, followed by AVR 2 and AVR 1.

Recommendations: Gold and silver

101. For gold and silver the Ministry recommends a two percent AVR with a 10 percent APR applying to mine developments with accounting profits of more than $2 million. It recommends retaining the existing threshold whereby royalties are only payable when net sales revenues are more than $200,000 for a calendar year.

102. The Ministry considers that this royalty option will provide the highest returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and will have a negligible impact on the number of companies that decide to proceed with a mine development.

Appendix 4: Platinum group elements modelling

Scenarios modelled for PGE

103. The Ministry's PGE models are based on hypothetical 3E PGE deposits. 3E PGE is a combination of platinum, palladium and gold. Three scenarios have been modelled in the same manner as for coal and gold:

    a. **Base scenario**: a mine with a plateau production of one million tonnes per annum and the assumptions noted in Table 12 below.

    b. **Conservative scenario**: a mine with a lower production plateau of 700,000 tonnes per annum but with a lower international benchmark price (US$800 per ounce), and higher operating costs (US$800 per ounce) and higher development costs (US$250 per tonne of ore milled).

    c. **Optimistic scenario**: a mine with a higher production plateau of two million tonnes per annum, a higher international benchmark price of (US$1,200 per ounce), and lower operating costs (US$700 per ounce) and lower development costs (US$110 per tonne of ore milled).

Table 12: PGE assumptions

Input	Range or value
Base	1.0 million tonnes pa
Conservative	0.7 million tonnes pa
Optimistic	2.0 million tonnes pa
Maximum concentration - gold (grams/tonne)	4 (all scenarios)
Recovery - (% of PGE recovered from ore)	75%
International benchmark price (US$/troy ounce)	1,000 (base), 800 (conservative), 1,200 (optimistic)
Operating costs (US$ /troy ounce)	750 (base), 800 (conservative), 700 (optimistic)
Fixed operating costs (NZ$ million/ye	10 (all scenarios)
Exploration costs (NZ$ million/year)	10 (all scenarios)
Development costs (US$/tonne, ore	150 (base), 250 (conservative), 110 (optimistic)
Other capex (NZ$ million)	500,000 (all scenarios)
Diminishing value	15%
Indirect costs	1% of production costs
Decommissioning costs	2% of development costs
Operating and capital overhead allowance	1% of production and capital costs
Inflation	
- Commodity price	3%
- Opex	3%
Mine life (years)	20

Table 13: Probability distributions used for PGE modelling

	Distribution applied	Mean	Standard deviation	Minimum	Maximum
Base scenario one million tonnes pa					
Recovery factor (%)	Normal	0.75	0.08		
International benchmark price US$	Normal	1,000	156.06		
Operating expenditure (US$/oz)	Normal	750	78.03		
Development costs (NZ$ million)	Normal	150	7.80		
Exchange rate (US$/NZ$)	Normal	0.65	0.08		
Production (million tonnes)					
-2016	Triangular	0.5		0.00	1.00
-2017	Triangular	0.8		0.30	1.30
-2018	Triangular	1		0.50	1.50
-2019	Triangular	1		0.50	1.50
-2020	Triangular	1		0.50	1.50
-2021	Triangular	1		0.50	1.50
Conservative scenario: 700,000 tonnes pa					
Recovery factor (%)	Normal	0.75	0.08		
International benchmark price US$	Normal	800	156.06		
Operating expenditure (US$/oz)	Normal	800	78.03		
Development costs (NZ$ million)	Normal	250	7.80		
Exchange rate (US$/NZ$)	Normal	0.65	0.08		
Production (million tonnes)					
-2016	Triangular	0.35		-0.15	0.85
-2017	Triangular	0.56		0.06	1.06
-2018	Triangular	0.7		0.20	1.20
-2019	Triangular	0.7		0.20	1.20
-2020	Triangular	0.7		0.20	1.20
-2021	Triangular	0.7		0.20	1.20
Optimistic scenario: two million tonnes pa					
Recovery factor (%)	Normal	0.75	0.08		
International benchmark price US$	Normal	1,200	156.06		
Operating expenditure (US$/oz)	Normal	700	78.03		
Development costs (NZ$ million)	Normal	110	7.80		
Exchange rate (US$/NZ$)	Normal	0.65	0.08		
Production (million tonnes)					
-2016	Triangular	1		0.5	1.5
-2017	Triangular	1.6		1.1	2.1
-2018	Triangular	2		1.5	2.5
-2019	Triangular	2		1.5	2.5
-2020	Triangular	2		1.5	2.5
-2021	Triangular	2		1.5	2.5

Analysis of options: PGE

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

104. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the 10 percent APR option, it would take six years of production before royalty payments began in the base case scenario, they would never be paid in the conservative scenario, and it would take three years before royalty payments began in the optimistic scenario.

Internationally competitive

105. The Ministry has attempted to indicate what the Crown share would look like in different jurisdictions using the base case scenario as a benchmark. Only jurisdictions that are major PGE producers have been chosen. Using the base scenario assumptions, a two percent AVR equates to approximately a 10 percent APR. This proportion has been applied across other jurisdictions in the same manner as described for gold (see Appendix 3) to obtain the indicative Crown share figure. The Ministry acknowledges the crudeness of this measure. Using the more optimistic assumptions in the optimistic scenario, a 4.8 percent AVR would generate the same net present value (NPV) to the Crown as a 10 percent APR. Table 14 below is included purely to provide a sense of relative scale.

106. Table 14 shows that New Zealand's total Crown share is very similar to that of Ontario but significantly more competitive than Russia, Montana or South Africa. Using the more optimistic assumptions in Scenario 2 would mean that Russia, because of its lower corporate tax rate, would be more competitive than New Zealand. Even under these more optimistic assumptions, however, New Zealand would continue to be more competitive than Montana and South Africa. The Ministry notes that this analysis does not take into account other important drivers of competitiveness that are known to affect companies' investment decisions.

Table 14: Comparison of Crown share by regime (PGE)

	Royalty method	Royalty rate	Tax rate	Indicative Crown take
Canada - Ontario*	APR	10.0%	27.0%	34.3%
New Zealand (10% APR or hybrid)		10.0%	28.0%	35.2%
New Zealand (current)	AVR	2.0%	28.0%	35.2%
Russia	AVR	4.8%	20.0%	44.0%
USA - Montana	AVR	1.6%	41.8%	50.3%
South Africa**	AVR	max 7%	33.0%	56.5%

** Ontario has a tiered APR of between 10% and 17%. Based on the base scenario, a 10% APR would be applied.*

*** South Africa applies 33% tax to foreign-owned South African branches and 28% for local companies.*

Potential Crown revenue versus company return

107. Table 15 below shows the impact of various royalty regimes for the one million tonne per annum PGE mine (base scenario). The PGE mine is profitable in over 98 percent of the iterations modelled before a royalty is applied, applying a 10 percent discount rate. The internal rate of return is around 17 percent across all the royalty options modelled. The pure APR and hybrid options provide more than $15 million of upside to the Crown in the median mine scenario, and more than $42 million in the P10 scenario. The IRR to the miner drops from 17.0 percent in the AVR 2 median case to 16.6 percent in the Hybrid 2 median case. This highlights the relative importance of other factors (for example, production volumes, commodity price, and development costs) to the economics of this project compared with royalties.

108. The conservative scenario shows that by stress-testing a number of key variables, even a relatively large mine development can become uneconomic, using a hurdle rate of 10 percent. It should be noted that this mine scenario would be uneconomic regardless of whether or not a royalty is applied.

109. By contrast, the optimistic scenario shows that at higher production volumes and commodity prices, and lower unit development and operating costs, a PGE mine can be highly profitable. The IRR to the operator is more than 40 percent under each royalty option and, importantly, there is little fluctuation in IRR across the royalty options. The operator would have an IRR of 43 percent if no royalty applied but 40.3 percent under the Hybrid 2 royalty option.

110. Overall, a straight AVR 2 offers upside across all distributions in all mine scenarios relative to the status quo. However, the pure APR and hybrid options provide significantly more upside relative to the status quo in the P50 and P10 scenarios for the base case and Scenario 2.

Table 15: Royalty take (NZ$ million) for future mine developments (PGE)

	One million tonne pa mine			700,000 tonne pa mine			Two million tonne pa mine		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo	15.5	24.4	34.0	4.0	8.2	19.2	43.7	60.0	76.9
1% AVR	8.2	12.4	17.0	4.0	7.1	38.5	21.9	30.0	38.5
2% AVR	16.4	24.7	34.0	8.0	14.2	76.9	43.7	60.0	76.9
10% APR	13.7	39.8	76.1	0.0	0.0	234.6	102.4	166.3	234.6
Hybrid 1%AVR/10% APR	14.8	40.5	76.5	4.0	7.4	234.6	102.4	166.3	234.6
Hybrid 2%AVR/10% APR	19.0	41.2	76.9	8.0	14.3	234.6	102.4	166.3	234.6
1% AVR versus status quo	-7.4	-12.1	-17.0	0.0	-1.1	19.2	-21.9	-30.0	-38.5
2% AVR versus status quo	0.8	0.3	0.0	4.0	6.0	57.7	0.0	0.0	0.0
10% APR versus status quo	-1.8	15.3	42.1	-4.0	-8.2	215.4	58.7	106.3	157.6
Hybrid 1%AVR/10%APR versus status quo	-0.8	16.0	42.5	0.0	-0.8	215.4	58.7	106.3	157.6
Hybrid 2%AVR/10%APR versus status quo	3.5	16.7	42.9	4.0	6.1	215.4	58.7	106.3	157.6

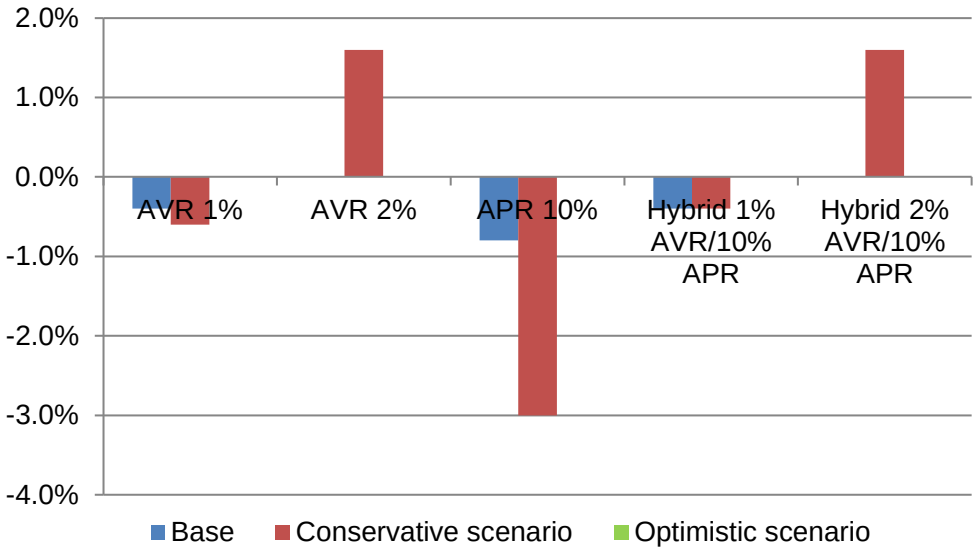
111. Based on the results above, Hybrid 2 has been ranked best, Hybrid 1 second, both AVR options third, and the pure APR fifth.

Objective 2: Neutral / non-distortionary

112. Figure 8 highlights the difference in commercial success rates compared to a regime with no royalty, assuming a hurdle rate of a 10 percent IRR to the company. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to the status quo royalty regime. If the alternative regime is less than zero, it represents more commercial successes compared to the status quo.

113. The royalty options under the base-case scenario resulted in between zero and four additional mines over the 500 model simulations. In the conservative scenario, up to 15 additional mines could be expected over the 500 model simulations using a pure APR, while by contrast up to eight fewer commercial successes could be expected using the AVR 2 or Hybrid 2 royalty options. In the optimistic scenario there was no difference under any of the royalty options reviewed.

Figure 8: Reduction in commercial success rate relative to status quo



Note: Optimistic scenario is zero across all royalty options

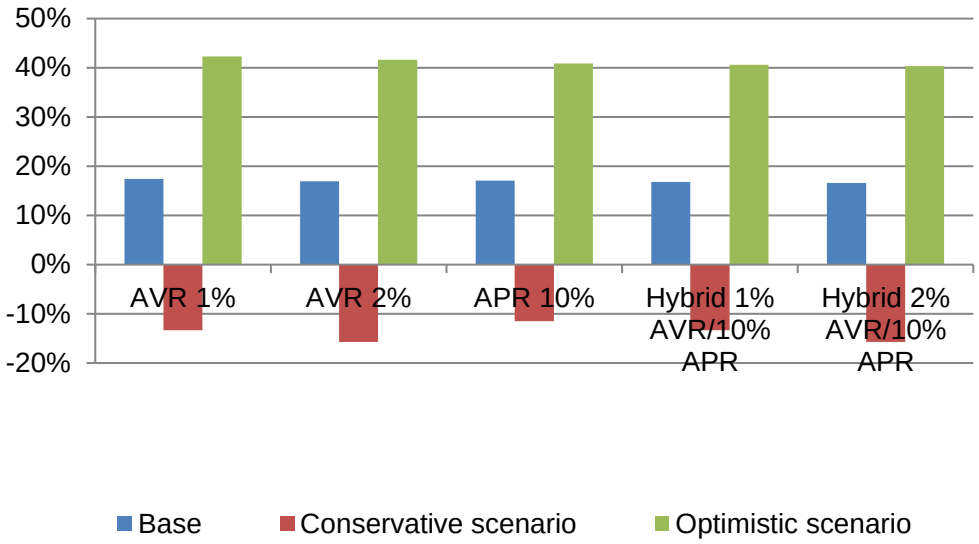
114. Based on the results shown above, the pure APR option performs best, AVR 1 second, Hybrid 1 third, and AVR 2 and Hybrid 2 fourth equal. However, given the relatively small number of potential mines affected (seven fewer mines out of 500 simulations for Hybrid 2 relative to the pure APR), this "neutral/non-distortionary" objective should be given relatively little weight overall.

Objective 3: Appropriate risk-sharing between private investment and the Crown

115. Royalty options have been assessed against this objective by measuring the extent to which each option improves returns to companies for marginal P90 mine developments while improving returns to the Crown in highly profitable P10 developments relative to the status quo.

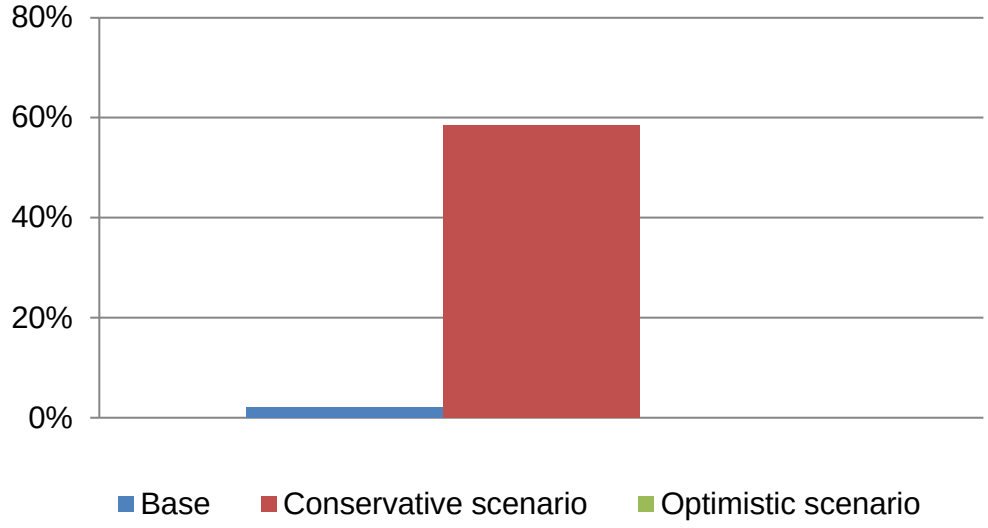
116. Under the base-case assumptions, the base and optimistic mine development scenarios would be developed but the conservative scenario would not. The base scenario mine development returns an internal rate of return to the operator of more than 16 percent across all royalty options, while for the optimistic scenario the returns would be more than 40 percent under each royalty option (see Figure 9 below).

Figure 9: Internal rates of return to operator (PGE)



117. The Monte Carlo simulation highlighted the sensitivities of each mine development pre-application of a royalty. The base mine development scenario was profitable in 98 percent of the model iterations, while the optimistic scenario was profitable in all model iterations. In the conservative scenario, only in 42 percent of the model iterations would the mine meet a commercial hurdle rate of 10 percent pre-application of royalties.

Figure 10: Probability of unsuccessful mine development with no royalty (PGE)



Note: Optimistic scenario is zero

Table 16: Net present value to operator (NZ$ million) for future mine developments (PGE)

	One million tonne pa mine			700,000 tonne pa mine			Two million tonne pa mine		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo	83.9	266.4	523.2	-214.2	-35.3	113.5	702.6	1,149.5	1,629.7
1% AVR	89.8	275.1	534.5	-214.2	-35.0	118.5	718.9	1,172.2	1,658.1
2% AVR	82.8	266.4	523.0	-218.0	-41.3	112.2	702.6	1,149.5	1,629.7
10% APR	86.2	255.4	491.3	-209.6	-28.5	111.9	661.5	1,075.8	1,518.2
Hybrid 1%AVR/10% APR	85.6	255.1	491.0	-214.2	-35.0	111.5	661.5	1,075.8	1,518.2
Hybrid 2%AVR/10% APR	82.8	254.9	490.7	-218.0	-41.3	109.9	661.5	1,075.8	1,518.2
1% AVR versus status quo	5.9	8.8	11.3	0.0	0.3	5.0	16.3	22.7	28.4
2% AVR versus status quo	-1.1	0.0	-0.3	-3.8	-6.0	-1.2	0.0	0.0	0.0
10% APR versus status quo	2.3	-11.0	-32.0	4.6	6.8	-1.6	-41.2	-73.7	-111.4
Hybrid 1%AVR/10%APR versus status quo	1.6	-11.2	-32.2	0.0	0.3	-2.0	-41.2	-73.7	-111.4
Hybrid 2%AVR/10%APR versus status quo	-1.1	-11.5	-32.5	-3.8	-6.0	-3.5	-41.2	-73.7	-111.4

118. Table 16 above shows that there is little or no upside to the miner in the P90 case under any of the royalty options reviewed for the base and conservative mine development scenarios. In contrast, each royalty option, except AVR 1, provides for substantial downside to the miner in a P90 case in the optimistic scenario. As shown, however, the optimistic scenario is highly profitable to the miner. The net present value to the operator in the P90 case of that scenario, using a 10 percent hurdle rate, is over $660 million under each royalty option.

119. The pure APR and hybrid options provide very substantial upside to the Crown under each development scenario.

120. Assessed against the "appropriate risk-sharing" objective, the pure APR option has been ranked best, Hybrid 1 second, Hybrid 2 third, AVR 2 fourth, and AVR 1 fifth.

Recommendations: PGE

121. For PGE, the Ministry recommends the Hybrid 2 option – that is, the higher of a two percent AVR and a 10 percent APR.

122. The Ministry considers that this will provide the highest returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and will have a negligible impact on the number of companies that decide to proceed with a mine development.

Appendix 5: Ironsands modelling

Scenarios modelled for ironsands

123. In February 2011 the Ministry engaged a Canadian-based consulting company specialising in the mining and metals industry to review the Asia-Pacific titanomagnetite market, including the future outlook. This work has been supplemented by information obtained from current ironsands explorers and domestic players.

124. The Ministry has adopted a relatively conservative long-term iron ore price of US$88 per tonne. This is significantly lower than the US$100 per tonne used by some of the domestic ironsand players and the price forecasts used by the investment banks Morgan Stanley[16] and Macquarie[17] (US$110 per tonne) in commodities research published in May 2012 and August 2012. In order to reflect these sensitivities, the Ministry has modelled scenarios around an alternative long-term iron ore price of US$100 per tonne.

125. In order to derive a New Zealand FOB price, the following method and assumptions have been used:

    a. US 142 cents per dry metric tonne unit - long-term Rio Tinto Hammersley fines (62 percent Fe) benchmark price, quoted FOB Port Hedland.

    b. A long-term freight rate from Port Hedland to Qingdao in China of US$13 per tonne is then added to get a delivered price in China (CFR Qingdao).

    c. The delivered price is discounted by 30 percent to account for the lower quality of New Zealand ironsand relative to the benchmark Hammersley fines and to provide an incentive for Chinese steel mills to use an unconventional source of iron in their blast furnaces.

    d. The delivered price in China is further discounted for the lower iron ore content in New Zealand ironsands (57 percent) relative to the benchmark Hammersley fines.

    e. The long-term freight rate from Qingdao to New Zealand (US$27.50 per tonne) is then deducted to give a NZ FOB price per tonne.

126. The combined impact of quality discounts and freight rates means that the NZ FOB price is approximately half that of the internationally quoted benchmark price.

127. Four scenarios have been modelled:

[16] Metal Sparks, Morgan Stanley Research Asia/Pacific, 1 August 2012.

[17] Macquarie Commodities Research, 17 May 2012.

a. **Base** (**low price) scenario**: an offshore development of eight million tonnes per annum and an onshore development of two million tonnes per annum. Operating and capital expenditure for the onshore development are 80 percent those of the offshore development.

b. **Base (industry price) scenario**: the same assumptions as above but with a higher commodity price of US$ 100 per tonne.

c. **Optimistic (low price) scenario**: an offshore development of 18.75 million tonnes per annum and an onshore development of 6.25 million tonnes per annum. Operating and capital expenditure for the onshore development are 80 percent those of the offshore development. This scenario is based on what can be sold in the Chinese market given the technology used in Chinese steel mills. As China has accounted for virtually all of the world's demand growth in recent years, China has been used as a proxy for the world. The optimistic scenario assumes that the proportion of titanomagnetite ores used in the Chinese steel-making market increased from the current figure of approximately 2.5 percent to 7.5 percent, with New Zealand taking 50 percent of this market growth. The scenario is used as a representative upper limit on potential production.

d. **Optimistic (industry price) scenario**: the same assumptions as above but with a higher commodity price of US$100 per tonne.

128. An additional case had been modelled using more conservative figures for production, price and development costs. This conservative scenario failed to meet the 10 percent threshold rate in all but one of the 500 iterations modelled, and it has therefore been excluded.

Table 17: Ironsands assumptions

Input	Range or value
Exchange rate (US$/NZ$)	0.65
Year 1 production	2017 (base), 2016 (optimistic)
Mineral concentration	22%
Production schedules	Y1, Y2, Y3, Y4, Y5, Y6
- Base	10%, 20%, 30%, 40%, 80%, 100%
- Optimistic	20%, 34%, 40%, 89%, 100%, 100%
Distribution of reserve by location	
- Offshore	20% (base), 8% (optimistic)
- Onshore	80% (base), 82% (optimistic)
Maximum production (Million tonnes pa)	10 (base), 25 (optimistic)
Benchmark price profile (US cents per dmtu)	183, 152, 141, 120, 120, 130, 142 (Y7 to Y35) (optimistic - 160 from year 2 to year 35)
Iron ore content (% Fe)	57
Price discount to international benchmark	30%
Long-term freight rates (US$ per tonne)	
- Port Hedland to Qingdao	13
- New Zealand to Qingdao	27.5
Production opex (US$ per tonne)	
- Offshore	23 (base), 20.5 (optimistic)
- Onshore	80% of offshore rate
Exploration costs (US$ million)	
- Offshore	10 all scenarios
- Onshore	5 all scenarios
Total development costs (US$ per tonne)	
- Offshore	52 (base), 72 (optimistic)
- Onshore	80% of offshore rate
Development costs for max production (US$ million)	
- Offshore	416 (base), 1,620 (optimistic)
- Onshore	83 (base), 432 (optimistic)
Depreciation based on production volume over remaining probable reserve	Reserves based on cumulative production for each scenario
Other capex (US$ million) applied each year	24.96 (base), 102.60 (optimistic)
Other capex diminishing values	15%
Decommissioning costs	10%
Inflation	3%
Land access fee - onshore (NZ$ per tonne)	0.7 (base), 1.0 (optimistic)

Table 18: Distribution probabilities used for ironsands modelling

	Distribution applied	Mean	Standard deviation	Minimum	Maximum
Base (low price): 10 million tonnes pa					
Price (% of benchmark)	Normal	1.0	0.078		
Exchange rate (US$/NZ$)	Normal	0.7	0.078		
Operating expenditure (US$ per tonne)	Normal	23.0	3.902		
Capital expenditure (US$ per tonne)	Normal	52.0	3.902		
Freight (NZ to China - US$ per tonne)	Normal	27.5	1.951		
Concentration (% of mass mined)	Normal	0.2	0.031		
Production (million tonnes)					
-2016	Triangular	0.0		0	0
-2017	Triangular	1.0		0.7	1.3
-2018	Triangular	2.0		1.4	2.6
-2019	Triangular	3.0		2.1	3.9
-2020	Triangular	4.0		2.8	5.2
-2021	Triangular	8.0		5.6	10.4
- 2022+	Triangular	10.0		7	13
Base (industry price): 10 million tonnes pa					
Price (% of benchmark)	Normal	1.0	0.078		
Exchange rate (US$/NZ$)	Normal	0.7	0.078		
Operating expenditure (US$ per tonne)	Normal	23.0	3.902		
Capital expenditure (US$ per tonne)	Normal	52.0	3.902		
Freight (NZ to China - US$ per tonne)	Normal	27.5	1.951		
Concentration (% of mass mined)	Normal	0.2	0.031		
Production (million tonnes)					
-2016	Triangular	0.0		0	0
-2017	Triangular	1.0		0.7	1.3
-2018	Triangular	2.0		1.4	2.6
-2019	Triangular	3.0		2.1	3.9
-2020	Triangular	4.0		2.8	5.2
-2021	Triangular	8.0		5.6	10.4
- 2022+	Triangular	10.0		7	13
Optimistic (low price): 25 million tonnes pa					
Price (% of benchmark)	Normal	1.2	0.078		
Exchange rate (US$/NZ$)	Normal	0.6	0.078		
Operating expenditure (US$ per tonne)	Normal	20.5	3.902		
Capital expenditure (US$ per tonne)	Normal	72.0	3.902		
Freight (NZ to China - US$ per tonne)	Normal	27.5	1.951		
Concentration (% of mass mined)	Normal	0.2	0.031		
Production (million tonnes)					
-2016	Triangular	5.9		4.2	7.7
-2017	Triangular	10.1		7.1	13.1
-2018	Triangular	11.9		8.3	15.4
-2019	Triangular	25.0		17.5	32.5
-2020	Triangular	25.0		17.5	32.5
-2021	Triangular	25.0		17.5	32.5
- 2022+	Triangular	25.0		17.5	32.5
Optimistic (industry price): 25 million tonnes pa					
Price (% of benchmark)	Normal	1.2	0.078		
Exchange rate (US$/NZ$)	Normal	0.6	0.078		
Operating expenditure (US$ per tonne)	Normal	20.5	3.902		
Capital expenditure (US$ per tonne)	Normal	72.0	3.902		
Freight (NZ to China - US$ per tonne)	Normal	27.5	1.951		
Concentration (% of mass mined)	Normal	0.2	0.031		
Production (million tonnes)					
-2016	Triangular	5.9		4.2	7.7
-2017	Triangular	10.1		7.1	13.1
-2018	Triangular	11.9		8.3	15.4
-2019	Triangular	25.0		17.5	32.5
-2020	Triangular	25.0		17.5	32.5
-2021	Triangular	25.0		17.5	32.5
- 2022+	Triangular	25.0		17.5	32.5

Analysis of options: Ironsands

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

129. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the 10 percent APR option, it would take eight years of production before royalty payments began in the base (low price) scenario, six years in the base (industry price) scenario, and five years in both the optimistic (low price) and optimistic (industry price) scenarios.

Internationally competitive

130. The Ministry has attempted to provide an indication of Crown share by jurisdiction using the base scenarios as a benchmark. Using the low-price and industry-price assumptions for the base model assumptions as benchmarks, a 3.5 percent AVR equates approximately to a 10 percent APR. This proportion has been applied across other jurisdictions in the same manner as described for gold (see Appendix 3) and PGE (see Appendix 4) to obtain the indicative Crown share figure. Table 19 below presents indicative Crown share across various jurisdictions (the obvious simplifications in this approach should be noted).

131. Table 19 below shows that New Zealand's total Crown share would be more competitive under all the royalty options analysed than any of the other jurisdictions reviewed.

Table 19: Comparison of Crown share by regime: Ironsands

	Royalty method	Royalty rate	Tax rate	Indicative Crown take
New Zealand - AVR 1	AVR	1.0%	28.0%	30.1%
New Zealand - 1996 MPM	Hybrid	1%/5%	28.0%	31.6%
New Zealand - AVR 2	AVR	2.0%	28.0%	32.1%
New Zealand - APR or hybrid	Hybrid	1% or 2%/10%	28.0%	35.2%
Canada - BC	Hybrid	2%/13%	26.5%	36.1%
Canada - Quebec	APR	16.0%	28.5%	39.9%
Canada - Newfoundland and Labrador	APR	15.0%	30.5%	40.9%
Australia - Tasmania**	APR + MRRT*	Max. 5%	30.0%	45.8%
Australia - Queensland**	AVR + MRRT	2.7%	30.0%	45.8%
Australia - SA**	AVR + MRRT	3.5%	30.0%	45.8%
Australia - NSW**	AVR + MRRT	4.0%	30.0%	45.8%
Australia - WA - beneficiated ore**	AVR + MRRT	5.0%	30.0%	45.8%
Australia - WA - fine ore**	AVR + MRRT	5.6%	30.0%	45.8%
Australia - NT**	APR + MRRT	20.0%	30.0%	45.8%
Australia - WA - lump ore**	AVR + MRRT	7.5%	30.0%	45.8%
United States - Minnesota	AVR	2.0%	44.8%	48.0%
United States - Michigan	AVR	Max. 7%	41.0%	52.8%

** Mineral Resources Rent Tax*

*** State royalties are fully deductible against MRRT (KPMG Australia analysis). Relates to iron ore, primarily hematite and magnetite. 45.8% Crown take is a maximum take.*

Potential Crown revenue versus company return

132. Table 20 below shows the impact of various royalty regimes for the 10 million tonne per annum ironsands development (base scenario), with eight million tonnes assumed to be produced offshore and two million tonnes produced onshore. The 1996 Minerals Programme for Minerals (MPM) royalty of the higher of a one percent AVR and a five percent APR has been used as a proxy for the status quo. The pure APR and hybrid options provide more than $20 million of upside in the P50 development scenario, and more than $50 million in the P10 scenario.

133. Using a higher long-term price in the base (industry price) scenario, the potential royalty return to the Crown increases markedly, with $52 million or more of upside relative to the status quo in the P50 scenario for the pure APR and hybrid options, and over $95 million of upside in the P10 scenario.

134. For the optimistic 25 million tonne per annum ironsands development, there is very substantial upside to the Crown in the pure APR and hybrid options relative to the status quo in both the low-price and the industry-price scenarios.

135. The AVR 1 option offers downside in all the scenarios across each iteration relative to the royalty rate applicable under the 1996 MPM. The pure APR and hybrid options, in contrast, provide very substantial upside.

Table 20: Royalty take (NZ$ million) for future mine developments (Ironsands)

	10 million tonne pa (low price)			10 million tonne pa (industry price)		
	P90	P50	P10	P90	P50	P10
Status quo (1% AVR / 5% APR)	29.1	45.9	75.7	43.3	71.0	113.4
1% AVR	27.4	34.5	43.1	31.7	40.9	50.9
2% AVR	54.7	68.9	86.3	63.5	81.8	101.8
10% APR	7.7	66.4	129.0	59.0	122.6	208.7
Hybrid 1%AVR/10% APR	31.2	77.2	139.4	71.6	131.8	217.6
Hybrid 2%AVR/10% APR	52.8	89.0	148.1	83.8	140.2	224.8
1% AVR versus status quo	-1.7	-11.5	-32.5	-11.6	-30.1	-62.5
2% AVR versus status quo	25.7	23.0	10.6	20.2	10.8	-11.6
10% APR versus status quo	-21.3	20.5	53.3	15.7	51.6	95.3
Hybrid 1%AVR/10%APR versus status quo	2.1	31.3	63.7	28.3	60.8	104.2
Hybrid 2%AVR/10%APR versus status quo	23.7	43.1	72.4	40.5	69.2	111.4

	25 million tonne pa (low-price)			25 million tonne pa (industry-price)		
	P90	P50	P10	P90	P50	P10
Status quo (1% AVR / 5% APR)	259.3	382.1	544.0	398.0	523.5	703.6
1% AVR	134.3	167.6	208.6	160.0	197.9	251.2
2% AVR	268.5	335.3	417.3	319.9	395.7	502.3
10% APR	429.5	676.1	1,014.1	719.1	978.1	1,337.1
Hybrid 1%AVR/10% APR	473.4	721.4	1,048.2	753.6	1,009.5	1,365.4
Hybrid 2%AVR/10% APR	516.4	757.1	1,080.8	790.6	1,042.9	1,405.5
1% AVR versus status quo	-125.0	-214.5	-335.3	-238.1	-325.6	-452.5
2% AVR versus status quo	9.3	-46.9	-126.7	-78.1	-127.8	-201.3
10% APR versus status quo	170.2	293.9	470.2	321.0	454.6	633.4
Hybrid 1%AVR/10%APR versus status quo	214.1	339.3	504.2	355.6	486.0	661.8
Hybrid 2%AVR/10%APR versus status quo	257.1	374.9	536.8	392.6	519.4	701.8

136. Based on the results shown above, Hybrid 2 has been ranked best, Hybrid 1 second, both AVR options third, and the pure APR fifth.

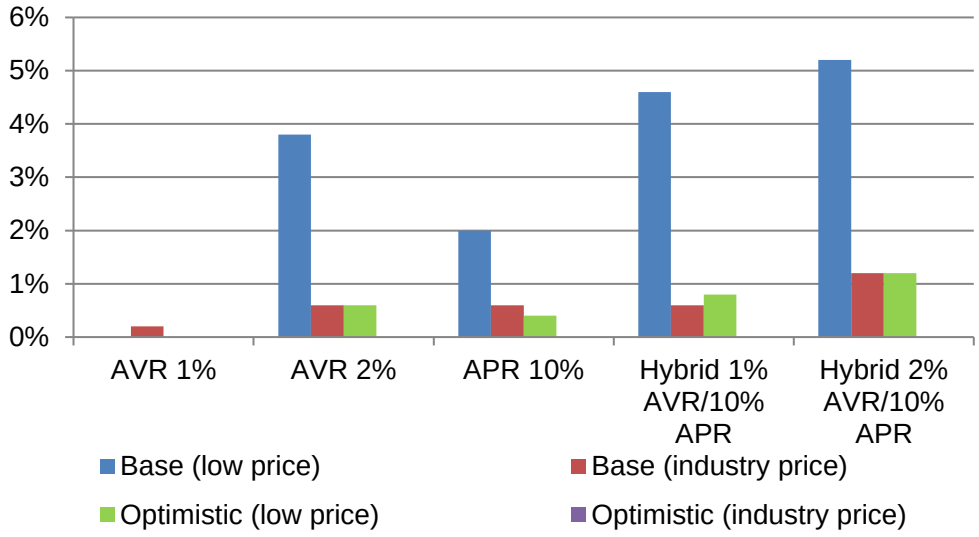
Objective 2: Neutral / non-distortionary

137. Figure 11 highlights the difference in commercial success rates compared to the status quo royalty regime (here, the royalty regime under the 1996 MPM), assuming a hurdle rate of a 10 percent IRR to the company. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to the status quo.

138. The results reflect the underlying economics of the mine project and the impact of commodity prices. In the base (low price) scenario, up to 26 developments out of the 500 modelled would fail to meet the 10 percent return threshold under the Hybrid 2 option, compared to the 1996 MPM royalty regime. This decreases to six developments when the higher industry price is used as the long-term iron ore benchmark.

139. In the optimistic (low price) scenario, up to six developments would be affected using the Hybrid 2 royalty. No developments would be affected in the optimistic (industry price) scenario.

Figure 11: Reduction in commercial success rate relative to status quo (Ironsands)



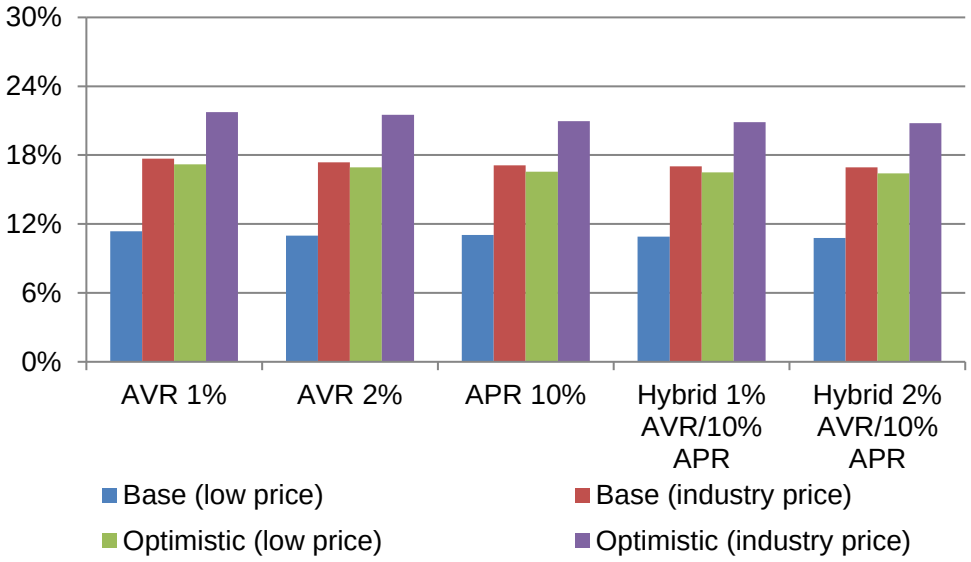
** Note optimistic (industry price) is zero across all scenarios*

140. On this basis, the AVR 1 option performs best, the pure APR option second, AVR 2 third, Hybrid 1 fourth, and Hybrid 2 fifth.

Objective 3: Appropriate risk-sharing between private investment and the Crown

141. Using the base-case assumptions, all of the mine development scenarios would be developed, but the base (low price) mine development scenario would be considered marginal (that is, the internal rate of return to the operator is between 10 and 15 percent).

Figure 12: Internal rates of return to operator (Ironsands)



142. The Monte Carlo simulation highlighted the relatively marginal nature of the base (low price) scenario. Of the 500 model iterations, 37 percent of the iterations in the base (low price) mine development scenario would fail to meet the 10 percent commercial threshold rate, even before a royalty has been applied. This decreases to eight percent using the higher industry price, and to less than two percent in the two optimistic production scenarios.

Figure 13: Probability of unsuccessful mine development with no royalty (Ironsands)

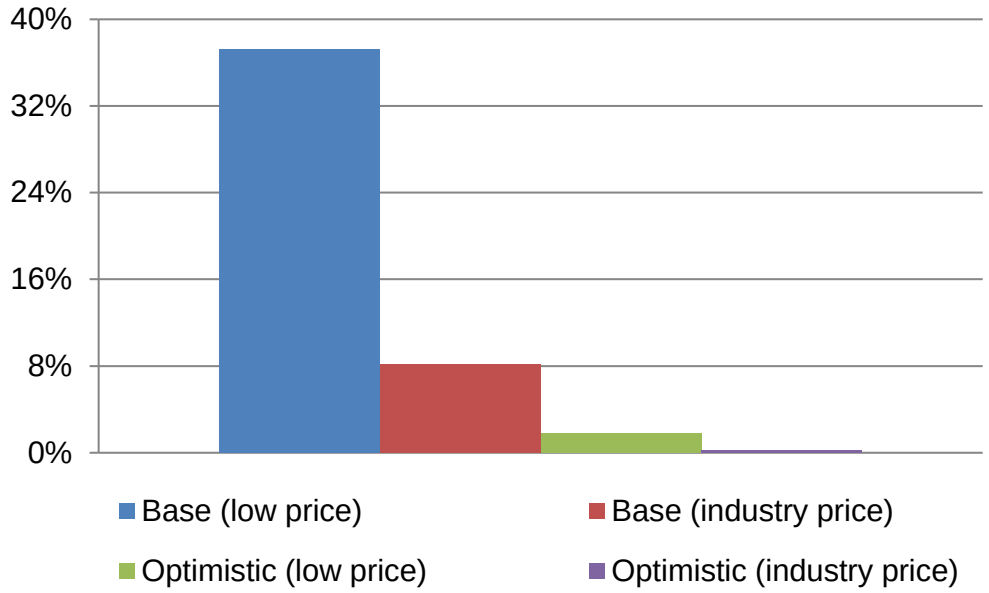


Table 21: Net present value to operator (NZ$ million) for future mine developments (Ironsands)

	10 million tonne pa (low price)			10 million tonne pa (industry price)		
	P90	P50	P10	P90	P50	P10
Status quo (1% AVR / 5% APR)	-398.7	77.6	546.5	29.9	508.2	1,120.3
1% AVR	-398.7	84.4	569.5	32.8	531.1	1,168.1
2% AVR	-421.0	59.6	540.1	7.7	500.7	1,131.6
10% APR	-379.0	63.6	508.4	20.5	471.8	1,051.0
Hybrid 1%AVR/10% APR	-396.7	54.3	502.3	11.1	466.7	1,045.5
Hybrid 2%AVR/10% APR	-414.4	45.3	497.8	1.7	461.5	1,039.9
1% AVR versus status quo	0.0	6.8	23.0	3.0	22.9	47.8
2% AVR versus status quo	-22.3	-18.0	-6.4	-22.1	-7.5	11.3
10% APR versus status quo	19.7	-14.0	-38.1	-9.4	-36.4	-69.3
Hybrid 1%AVR/10%APR versus status quo	2.0	-23.3	-44.2	-18.8	-41.6	-74.9
Hybrid 2%AVR/10%APR versus status quo	-15.7	-32.3	-48.7	-28.2	-46.7	-80.5

	25 million tonne pa (low-price)			25 million tonne pa (industry-price)		
	P90	P50	P10	P90	P50	P10
Status quo (1% AVR / 5% APR)	996.0	2,790.9	4,979.9	3,216.6	5,023.4	7,317.1
1% AVR	1,068.2	2,942.6	5,220.9	3,373.7	5,265.2	7,639.4
2% AVR	970.5	2,821.9	5,079.6	3,268.1	5,114.5	7,450.7
10% APR	890.4	2,573.3	4,645.2	2,982.9	4,693.3	6,855.9
Hybrid 1%AVR/10% APR	849.8	2,542.0	4,621.4	2,957.1	4,674.1	6,835.3
Hybrid 2%AVR/10% APR	809.2	2,513.9	4,597.6	2,934.1	4,646.3	6,813.9
1% AVR versus status quo	72.2	151.6	241.0	157.1	241.8	322.3
2% AVR versus status quo	-25.4	31.0	99.7	51.5	91.1	133.6
10% APR versus status quo	-105.5	-217.7	-334.7	-233.7	-330.1	-461.2
Hybrid 1%AVR/10%APR versus status quo	-146.1	-249.0	-358.5	-259.5	-349.3	-481.8
Hybrid 2%AVR/10%APR versus status quo	-186.7	-277.1	-382.3	-282.5	-377.1	-503.2

143. Table 21 above shows some upside to the miner using the AVR 1 royalty option across each P90 case for each mine development scenario. There is also some upside to the miner with the AVR 2 royalty option in the P90 case under the optimistic (industry price) scenario, and with the pure APR royalty option under the base case (low price) scenario. In each of the other P90 cases, however, each royalty option presents substantial downside to the miner relative to the 1996 MPM royalty regime.

144. The P90 case in the base (low price) scenario would not meet the commercial threshold required for development, even before a royalty is applied. The P90 cases under both optimistic production scenarios provide the miner with a net present value of over $850 million under all royalty options. So while the royalty options reviewed do not provide upside to the miner in the P90 cases modelled, these mine developments would either never be developed (for example the base (low price) scenario) or would be highly profitable to the miner.

145. In contrast, the pure APR and hybrid options provide very substantial upside to the Crown in each of the P10 cases. Based on this, the pure APR royalty option has been ranked best, Hybrid 1 second, Hybrid 2 third, AVR 2 fourth, and AVR 1 fifth.

146. To ensure a consistent approach across each mineral being reviewed, the Ministry has included the P90 and P10 results across all scenarios. The results show a relatively modest upside to the miner under the AVR 1 royalty option but a very substantial upside to the Crown in the P10 cases for each of the other royalty options. To provide an overall ranking, the respective upsides have been added together.

Recommendations: Ironsands

147. For ironsands, the Ministry recommends the Hybrid 2 option – that is, the higher of a two percent AVR and a 10 percent APR.

148. The Ministry considers that this option will provide the highest returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and will have a negligible impact on the number of companies that decide to proceed with a mine development.

Appendix 6: Phosphates modelling

Scenarios modelled for phosphates

149. The Ministry has engaged directly with Chatham Rock Phosphate Ltd and refined the input assumptions used for phosphates modelling accordingly. Three scenarios have been modelled:

    a. **Base scenario**: Total production of 1.5 million tonnes per annum, of which 0.5 million tonnes per annum is sold domestically and the rest exported to Asia. The international benchmark price used is US$175 per tonne, discounted by 31 percent for the lower quality of phosphate. The transport cost from Morocco is assumed to be US$70 per tonne. A further discount of 15 percent is applied to domestic New Zealand consumers as a market incentive to crowd out existing sources. The freight costs from New Zealand to Asia are assumed to be US$ 30 per tonne, which would be borne by the exporter. To ensure that all export phosphate gets placed, an export discount of US$10 per tonne has been applied. The US$/NZ$ exchange rate is assumed to be 0.65.

    b. **Conservative scenario**: Total production of 1.2 million tonnes per annum, of which 0.5 million is sold domestically. The international benchmark price used is US$150 per tonne, discounted by 31 percent for the lower quality of phosphate. The transport cost from Morocco is assumed to be US$70 per tonne. A further discount of 10 percent is applied to domestic New Zealand consumers as a market incentive to crowd out existing sources. The freight rate from New Zealand to Asia is assumed to be US$ 35 per tonne. To ensure that all export phosphate gets placed, an export discount of US$10 per tonne has been applied. A lower US$/NZ$ exchange rate of 0.55 has been used in this scenario.

    c. **Optimistic scenario**: Total production of three million tonnes per annum, of which one million tonnes per annum is sold domestically. The phosphate is assumed to be beneficiated, meaning that no quality discount is applied but operating costs increase by US$50 per tonne. A 15 percent discount has been applied to domestic New Zealand consumers as a market incentive to crowd out existing sources. A higher international benchmark price of US$200 per tonne has been used, as well as a higher US$/NZ$ exchange rate of 0.75. To ensure that all export phosphate gets placed, an export discount of US$10 per tonne has been applied. A lower freight rate of US$25 per tonne has been applied for exports from New Zealand to Asia.

Table 22: Phosphates assumptions

Input	Range or value
Exchange rate (US$/NZ$)	0.65 (base), 0.55 (conservative), 0.75 (optimistic)
Exchange rate (US$/Euro)	0.72 (base), 0.71 (conservative), 0.73 (optimistic)
Max annual production (million tonnes)	1.5 (base), 1.2 (conservative), 3 (optimistic)
Annual domestic sales (million tonnes)	0.5 (base and conservative), 1 (optimistic)
Annual export to Asia (million tonnes per annum)	1 (base), 0.7 (conservative), 2 (optimistic)
International benchmark price (US$/tonne)	175 (base), 150 (conservative), 200 (optimistic)
Discount for lower strength of NZ phosphate	31% (base and conservative), 0% (optimistic)
Domestic price discount	15% (base and optimistic), 10% (conservative)
Export price discount (US$ per tonne)	10 (all scenarios)
Freight costs (US$/tonne)	
- Morocco - NZ	70 (all scenarios)
- NZ - Asia	30 (base), 35 (conservative), 25 (optimistic)
Extraction costs (US$/tonne)	97 (base), 123 (conservative), 145 (optimistic)
Other variable costs (NZ$ million/tonne)	0
Other fixed costs (NZ$ million/year)	3 (all scenarios)
Exploration costs (NZ$ million)	16 (all scenarios)
Development costs (NZ$ million)	0 (all scenarios)
Other capex (NZ$ million/ 5 years)	0.5 (all scenarios)
Tax rate	28%
Depreciation average (over all mines)	20 years
Other capex diminishing values	15%
Indirect costs	1% of production costs
Decommissioning costs	2% of total development costs
Operating and capital overhead allowance	1% of production and capital costs
Discount rate	10%
Inflation	3%

Table 23: distribution probabilities used in phosphate modelling

	Distribution applied	Mean	Standard deviation	Minimum	Maximum
Base scenario: 1.5 million tonnes per annum					
Maximum domestic demand (million tonnes)	Normal	0.50	0.08		
International benchmark price (US$ per tonne)	Normal	175	19.51		
Market discount for domestic consumers (% of import parity price)	Triangular	0.15		0	0.16
Quality discount for NZ product	Normal	0.69	0.08		
Capital costs (% of capital costs)	Normal	1	0.08		
Freight cost (% of freight costs)	Triangular	1		0.9	1.1
Production					
-2015	Triangular	1		0.5	1.5
-2016	Triangular	1.5		1	2
-2017	Triangular	1.5		1	2
-2018	Triangular	1.5		1	2
-2019	Triangular	1.5		1	2
Exchange rate US$/NZ$	Normal	0.65	0.08		
Exchange rate Euro/NZ$	Normal	0.47	0.06		
Conservative scenario: 1.2 million tonnes per annum					
Maximum domestic demand (million tonnes)	Normal	0.50	0.08		
International benchmark price (US$ per tonne)	Normal	150	19.51		
Market discount for domestic consumers (% of import parity price)	Triangular	0.10		0	0.11
Quality discount for NZ product	Normal	0.69	0.08		
Capital costs (% of capital costs)	Normal	1	0.08		
Freight cost (% of freight costs)	Triangular	1		0.9	1.1
Production					
-2015	Triangular	1		0	1.0
-2016	Triangular	1.2		0.7	1.7
-2017	Triangular	1.2		0.7	1.7
-2018	Triangular	1.2		0.7	1.7
-2019	Triangular	1.2		0.7	1.7
Exchange rate US$/NZ$	Normal	0.55	0.08		
Exchange rate Euro/NZ$	Normal	0.39	0.06		
Optimistic scenario: 3 million tonnes per annum					
Maximum domestic demand (million tonnes)	Normal	1.00	0.08		
International benchmark price (US$ per tonne)	Normal	200	19.51		
Market discount for domestic consumers (% of import parity price)	Triangular	0.15		0	0.16
Quality discount for NZ product	Normal	1.00	0.08		
Capital costs (% of capital costs)	Normal	1	0.08		
Freight cost (% of freight costs)	Triangular	1		0.9	1.1
Production					
-2015	Triangular	2		1	2.0
-2016	Triangular	3.0		2.5	3.5
-2017	Triangular	3.0		2.5	3.5
-2018	Triangular	3.0		2.5	3.5
-2019	Triangular	3.0		2.5	3.5
Exchange rate US$/NZ$	Normal	0.75	0.08		
Exchange rate Euro/NZ$	Normal	0.55	0.06		

Analysis of options: Phosphates

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

150. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the 10 percent APR option for phosphates, a royalty would be paid in the first year of production in both the base and optimistic scenarios.

Internationally competitive

151. Florida, Queensland and South Africa have been used as points of comparison. The royalty regimes in those jurisdictions are as follows:

    a. Florida has a unit-based royalty of US$2.99 per tonne,[18] a state corporate tax of eight percent, and a federal tax of 35 percent.

    b. Queensland has a hybrid royalty, which is the higher of A$0.80 per tonne and the rate for each tonne of phosphate rock calculated using the following formula:

        i. R = $1 * G / 32.3 * Pcurr / $ 72.50, where

        ii. R is the royalty rate

        iii. G is the average P_2O_5 content of the phosphate rock for the return period

        iv. Pcurr is the average price for the return period of Moroccan phosphate rock with 32.3 percent P_2O_5 content, converted to Australian dollars at the average hedge settlement rate for the return period.

        The Federal corporate tax rate in Australia is 30 percent.

    c. South Africa has a tiered revenue-based royalty up to a maximum of seven percent. The tiers are calculated based on the ratio of earnings before interest and taxes to gross sales. The corporate tax rate in South Africa is 28 percent for local companies.

152. Using the assumptions used for the base scenario, the royalties in each of these jurisdictions would equate to the following:

    a. 1.9 percent AVR for Florida. Florida's phosphate has been discounted by 10 percent to account for its lower quality (29 percent P_2O_5 content) compared to Moroccan benchmark phosphate (32.3 percent P_2O_5 content) (that is, 2.99 / (175 * 91%).

    b. 1.4 percent AVR for Queensland calculated using the following assumptions:

[18] http://dor.myflorida.com/dor/tips/tip10b07-03.html.

i. G = 24, 24 percent being the assumed P_2O_5 content of Queensland phosphate in accordance with the notes in the Minerals Resources Regulation 2003

ii. a phosphate price of US$175 per tonne, converted to Australian dollars using a long-term US$/A$ exchange rate forecast of 0.81.

153. The Ministry has applied these rates to the base sceanrio and applied a 10 percent discount rate to present the information in net present terms.

Table 24: Comparison of Crown revenue by regime (Phosphates)

	Crown take - base scenario (NZ$ million)
1%AVR / 5% APR (1996 MPM)	213
Australia - Queensland	233
New Zealand - pure APR option	237
New Zealand - Hybrid 1 option	237
New Zealand - Hybrid 2 option	237
Florida	324
South Africa	343

Upside to the Crown

154. Table 25 below shows the potential royalty returns to the Crown across each mine development scenario and royalty option. Under the base-case assumptions, the hybrid options provide consistent upside to the Crown across all the mine development scenarios. The pure APR provides similar returns to the hybrid options in the base and optimistic scenarios, but almost nothing in the conservative scenario. The AVR options provide similar returns to the hybrid options in the conservative scenario, but lower returns in the base and optimistic scenarios.

Table 25: Royalty take (NZ$ million) for future mine developments (Phosphates)

	Base scenario			Conservative scenario			Optimistic scenario		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo - 1% AVR / 5% APR	24.4	33.7	70.0	20.7	26.5	37.5	75.0	124.8	186.7
1% AVR	24.0	30.3	38.0	20.7	26.3	33.5	72.5	85.4	97.4
2% AVR	48.1	60.5	76.0	41.4	52.6	67.1	144.9	170.8	194.8
10% APR	4.0	61.9	140.0	0.0	0.7	69.9	123.6	249.7	373.4
Hybrid 1%AVR / 10% APR	25.7	61.9	140.0	20.7	26.9	69.9	123.6	249.7	373.4
Hybrid 2%AVR / 10% APR	48.7	67.5	140.0	41.4	53.0	75.0	150.1	249.7	373.4
1% AVR versus status quo	-0.3	-3.5	-32.0	0.0	-0.2	-4.0	-2.6	-39.4	-89.3
2% AVR versus status quo	23.7	26.8	6.0	20.7	26.1	29.6	69.9	46.0	8.0
10% APR versus status quo	-20.3	28.2	70.0	-20.7	-25.8	32.4	48.5	124.8	186.7
Hybrid 1%AVR / 10%APR versus status quo	1.3	28.2	70.0	0.0	0.4	32.4	48.5	124.8	186.7
Hybrid 2%AVR / 10%APR versus status quo	24.4	33.7	70.0	20.7	26.5	37.5	75.0	124.8	186.7

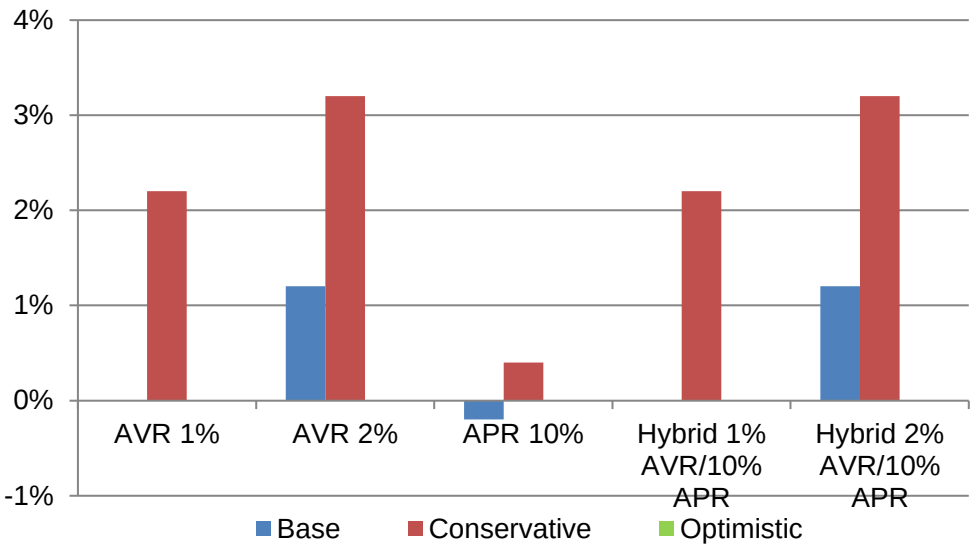
155. Based on the results shown above, Hybrid 1 ranks best, Hybrid 2 second, AVR 1 and AVR 2 equal third, and the pure APR option fifth.

Objective 2: Neutral / non-distortionary

156. Figure 14 highlights the difference in commercial success rates compared to the proxy status quo royalty regime of the 1996 MPM and assuming a hurdle rate of a 10 percent IRR to the company. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to a regime with no royalties. If it is less than zero it means more commercial successes.

157. The impact of different royalty regimes is only really noticeable in the conservative scenario, and this case would not be profitable to develop under base-case assumptions, even before a royalty was applied.

Figure 14: Reduction in commercial success rate relative to status quo (Phosphates)



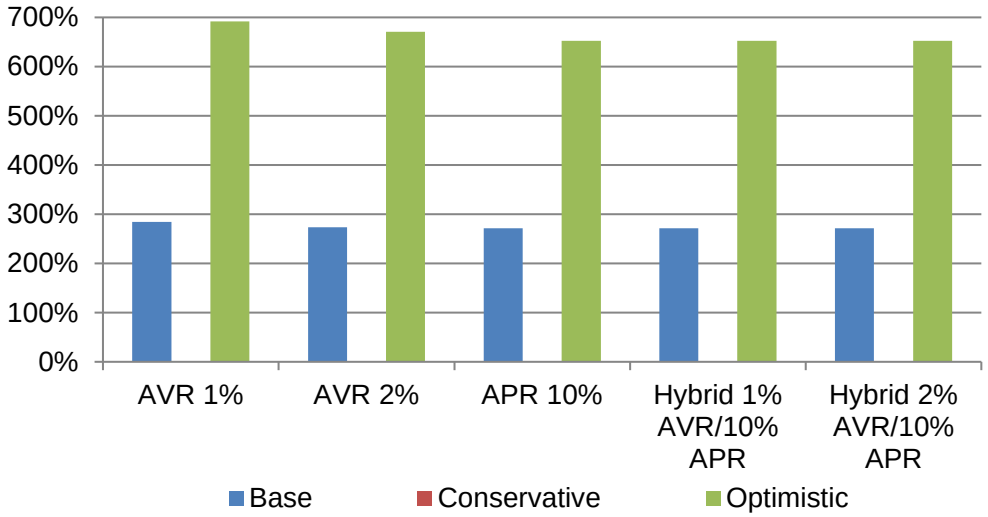
Note: Optimistic case is zero across all royalty options.

158. The pure APR option performs best, AVR 1 and Hybrid 1 are equal second, and AVR 2 and Hybrid 2 are equal fourth.

Objective 3: Appropriate risk-sharing between private investment and the Crown

159. Under the base-case assumptions, the base and optimistic mine development scenarios would be highly profitable under each royalty option reviewed. However, the mine is highly sensitive to changes in the exchange rate. Using a US$/NZ$ exchange rate of 0.8 across the base scenario mine life would reduce the net present value to the operator under the Hybrid 2 scenario from $429 million to $27 million. Using slightly lower production and price forecasts and higher freight rates would mean the mine would not meet the 10 percent commercial threshold rate.

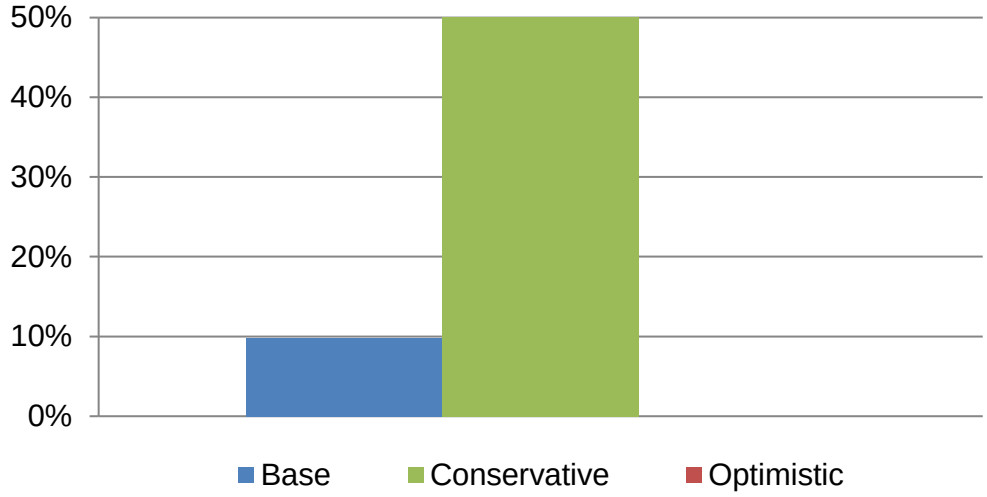
Figure 15: Internal rates of return to operator (Phosphates)



Conservative case is uneconomic under base-case assumptions.

160. Figure 16 below shows the proportion of developments that would not be developed before a royalty is applied out of 500 simulations modelled and using a 10 percent hurdle rate. In the base scenario, 1.8 percent of the 500 model simulations would be uneconomic before a royalty is applied. This increases to 41.6 percent in the conservative scenario and reduces to zero in the optimistic scenario.

Figure 16: Probability of unsuccessful mine development with no royalty (Phosphates)



Note: optimistic case is zero.

Table 26: Net present value to operator (NZ$ million) for future mine developments (Phosphates)

	Base scenario			Conservative scenario			Optimistic scenario		
	P90	P50	P10	P90	P50	P10	P90	P50	P10
Status quo - 1% AVR / 5% APR	-16.3	419.2	954.2	-942.0	-179.3	471.3	831.9	1,704.1	2,550.5
1% AVR	-16.3	421.2	978.5	-942.0	-179.3	472.6	831.9	1,731.5	2,618.3
2% AVR	-37.4	400.7	954.0	-966.5	-203.2	446.2	778.1	1,669.0	2,551.3
10% APR	1.5	397.3	903.8	-922.1	-152.9	448.7	797.0	1,614.2	2,416.1
Hybrid 1%AVR / 10% APR	-16.3	397.3	903.8	-942.0	-179.3	448.7	797.0	1,614.2	2,416.1
Hybrid 2%AVR / 10% APR	-37.4	396.5	903.8	-966.5	-203.2	443.6	778.1	1,614.2	2,416.1
1% AVR versus status quo	0.0	2.1	24.3	0.0	0.0	1.3	0.0	27.4	67.8
2% AVR versus status quo	-21.1	-18.4	-0.2	-24.5	-23.9	-25.1	-53.8	-35.1	0.9
10% APR versus status quo	17.8	-21.8	-50.4	19.9	26.3	-22.6	-34.9	-89.9	-134.4
Hybrid 1%AVR / 10%APR versus status quo	0.0	-21.8	-50.4	0.0	0.0	-22.6	-34.9	-89.9	-134.4
Hybrid 2%AVR / 10%APR versus status quo	-21.1	-22.6	-50.4	-24.5	-23.9	-27.7	-53.8	-89.9	-134.4

161. Table 26 above shows that the pure APR royalty option provides some upside to the miner in the P90 cases in both the base and conservative scenarios, compared with 1996 MPM royalty regime. In the P90 case of the optimistic scenario the pure APR would result in a downside of returns to the miner relative to the 1996 royalty regime, but in this instance the mine is highly profitable.

162. The AVR 1 royalty option is the only royalty option to provide upside to the miner across all mine development scenarios and across all probabilities.

163. The pure APR and hybrid options provide the most upside to the Crown in the P10 scenarios.

164. On balance, the pure APR has been ranked best in relation to the “appropriate risk-sharing” objective, with Hybrid 1 second, Hybrid 2 third, AVR 2 fourth, and AVR 1 fifth.

Recommendations: Phosphates

165. For phosphates, the Ministry recommends the Hybrid 2 option – that is the higher of a two percent AVR and a 10 percent APR.

166. The Ministry considers that this will provide fair returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and have a negligible impact on the number of companies that decide to proceed with a mine development.

Appendix 7: Seafloor massive sulphides modelling

Scenarios modelled for SMS

167. SMS are seafloor deposits that are found on hydrothermal vents on the sea floor. These deposits contain minerals including copper, zinc, lead and gold. Copper and gold are the highest-value minerals to mine.

168. Currently there are two companies that are operating in the Pacific and considering the potential of mining SMS in New Zealand: Neptune Minerals and Nautilus Minerals.

169. The scenarios modelled are drawn heavily from work undertaken by Transfield Worley on behalf of NZP&M.[19] As part of this work, Transfield Worley engaged with the National Institute of Water and Air (NIWA) and Geological and Nuclear Sciences (GNS). The Ministry has relied on the capital and operating expenditure assumptions in the report resulting from that work, but has used its own estimates for long-term gold and copper prices and for US$/NZ$ exchange rates.

170. The four scenarios modelled broadly replicate the operating models used by Neptune and Nautilus:

    a. **Base case (not concentrated) scenario**: This is a low-grade, high-volume approach (1.5 million tonnes per annum) similar to the seafloor "open cast" plan by Nautilus. The primary ore would be dewatered offshore and sold in a non-concentrated state to buyers.

    b. **Base case (concentrated) scenario**: This is the same scenario as above, except that the dewatered primary ore is transported onshore for secondary processing (concentration) before it is being sold. The concentrated ore would require further refining and smelting overseas. This tertiary ore processing has not been included in the capital cost estimates.

    c. **High-grade (not concentrated) scenario**: This is a high-grade, low-volume approach (625,000 tonnes), which is modelled here to illustrate the more selective approach favoured by Neptune. The primary ore would be dewatered offshore and sold in a non-concentrated state to buyers.

    d. **High-grade (concentrated) scenario**: This is the same scenario as above, except that the dewatered primary ore is transported onshore for secondary processing (concentration) before it is being sold. The concentrated ore would require further refining and smelting overseas. This tertiary ore processing has not been included in the capital cost estimates.

19 Seafloor Mining Kermadec Arc: the potential for New Zealand, August 2012.

Table 27: SMS assumptions

Input	Range or value
Exchange rate (US$/NZ$)	0.65 (all scenarios)
Max annual production (million tonnes)	1.5 (base), 0.625 (high grade)
Dewatered ore g/t gold	4 (base), 11 (high grade)
Dewatered ore % copper	7% (base), 8% (high grade)
International benchmark gold price (US$/oz)	1,500 (all scenarios)
International benchmark copper price (US$/tonne)	6,100 (all scenarios)
Ore value - not concentrated (% of international price)	40% (base and high grade for non concentrated scenarios)
Ore value - concentrated (% of international price)	60% (base and high grade for concentrated scenarios)
Copper freight to market (US$/t)	20
Production costs (US$/t)	
- dewatered only	120.26 (base), 232.85 (high grade)
- dewatered and concentrated	125.76 (base), 243.85 (high grade)
Exploration costs (US$ million)	55 base, 24 (high grade)
Development costs (US$ million)	
- dewatered only	631 (base), 482.3 (high grade)
- dewatered and concentrated	769 (base), 590.3 (high grade)
Other capital expenditure (US$ million per year)	5 (base), 3 (high grade)
Tax rate	28%
Depreciation average (over all mines)	20 years
Other capex diminishing values	15%
Indirect costs	1% of production costs
Decommissioning costs	2% of total development costs
Operating and capital overhead allowance	1% of production and capital costs
Discount rate	10%
Inflation	3%

Table 28: Distribution probabilities used in SMS modelling

All scenarios

	Distribution applied	Mean	Standard deviation	Minimum	Maximum
Exchange rate (US$/NZ$)	Normal	0.65	0.08		
Gold price (US$)	Normal	1,500	19.51		
Copper price (US$)	Normal	6,100	951.97		
Production multiplier	Normal	1	0.08		
Development costs multiplier	Triangular	1		0.60	1.40

Analysis of options: SMS

Objective 1: Fair financial return to the Crown

Guaranteed minimum return at the outset of production

171. The AVR and hybrid options provide a guaranteed minimum return at the outset of production. In the case of the 10 percent APR option, a royalty would be paid in the first year of production in all four mine development scenarios.

Internationally competitive

172. The only point of comparison available is the Solwara-1 project in Papua New Guinea. The royalty payable under the Papua New Guinea Mining (Royalties) Act 1992 is two percent of the net smelter return on all minerals produced. A further 0.25 percent royalty is payable to the Mineral Resource Authority. The corporate tax rate in Papua New Guinea is 30 percent.

173. The net smelter return is calculated as gross revenue minus transportation and refining costs. As the minerals have been fully refined, the sales value of the minerals is the international benchmark price – not the 60 percent of the international benchmark price modelled for concentrated ore, or the 40 percent of the international benchmark price modelled for dewatered ore. The 2.25 percent net smelter return is therefore likely to represent a far greater return to the Papua New Guinean government than any of the royalty options reviewed in this discussion document.[20]

Upside to the Crown

174. Using the P50 scenarios, the AVR 1 option results in lower royalty returns relative to the 1996 MPM royalty regime across each mine development scenario and across all iterations. The AVR 2 option also results in lower royalty returns in both the scenarios that involve concentration of the primary ore.

175. The pure APR and hybrid options offer substantial upside to the Crown relative to the 1996 royalty regime across each mine development scenario and across all iterations.

20 The government of Papua New Guinea has a 30 percent equity stake in the Solwara-1 project. The relatively high royalty rate is likely to represent the commercial interest the government has in the development.

Table 29: Royalty take (NZ$ million) for future mine developments (SMS)

	Base (not concentrated)			Base (concentrated)		
	P90	**P50**	**P10**	**P90**	**P50**	**P10**
Status quo - 1% AVR / 5% APR	39.1	46.7	56.4	84.3	99.6	122.4
1% AVR	22.5	26.1	30.4	33.8	38.8	46.8
2% AVR	45.1	52.2	60.9	67.7	77.6	93.6
10% APR	56.5	72.2	90.7	150.2	179.7	224.7
Hybrid 1%AVR / 10% APR	67.1	82.1	101.7	159.1	188.7	233.9
Hybrid 2%AVR / 10% APR	78.1	93.3	112.8	168.5	199.2	244.7
1% AVR versus status quo	-16.5	-20.6	-26.0	-50.4	-60.8	-75.6
2% AVR versus status quo	6.0	5.5	4.5	-16.6	-22.0	-28.8
10% APR versus status quo	17.4	25.5	34.3	65.9	80.1	102.3
Hybrid 1%AVR / 10%APR versus status quo	28.0	35.4	45.3	74.9	89.1	111.5
Hybrid 2%AVR / 10%APR versus status quo	39.1	46.7	56.4	84.3	99.6	122.4
	High-grade (not concentrated)			**High-grade (concentrated)**		
	P90	**P50**	**P10**	**P90**	**P50**	**P10**
Status quo - 1% AVR / 5% APR	22.4	27.1	33.0	52.1	63.1	74.8
1% AVR	15.8	18.2	21.5	33.8	27.4	32.1
2% AVR	31.6	36.3	43.1	67.7	54.8	64.1
10% APR	25.8	35.7	48.0	150.2	109.5	134.9
Hybrid 1%AVR / 10% APR	34.9	44.9	56.6	159.1	117.9	141.5
Hybrid 2%AVR / 10% APR	44.7	54.2	66.0	168.5	126.1	149.6
1% AVR versus status quo	-6.6	-8.9	-11.5	-18.2	-35.7	-42.7
2% AVR versus status quo	9.2	9.2	10.1	15.6	-8.3	-10.7
10% APR versus status quo	3.4	8.6	15.0	98.1	46.4	60.1
Hybrid 1%AVR / 10%APR versus status quo	12.5	17.8	23.6	107.0	54.9	66.7
Hybrid 2%AVR / 10%APR versus status quo	22.4	27.1	33.0	116.5	63.1	74.8

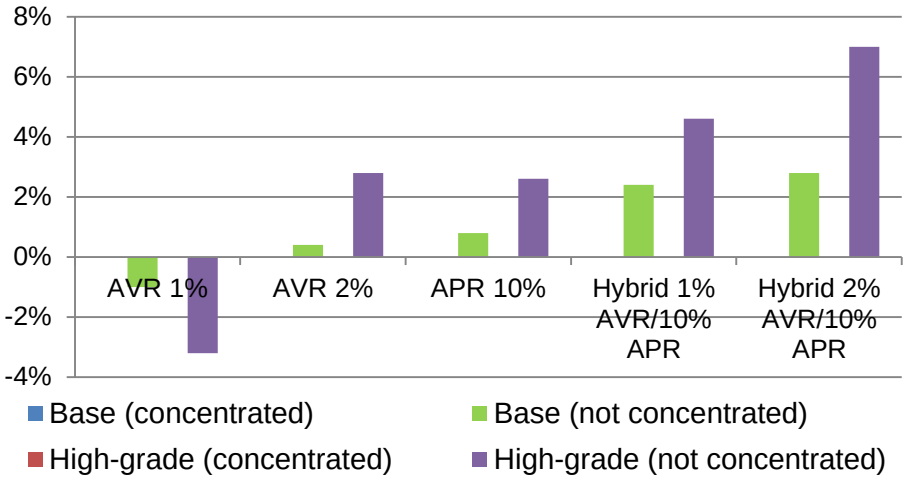
176. Based on the results shown above, Hybrid 2 has been ranked best, Hybrid 1 second, AVR 2 third, AVR 1 fourth, and the pure APR fifth.

Objective 2: Neutral / non-distortionary

177. Figure 17 below highlights the difference in commercial success rates compared to the proxy status quo royalty regime of the 1996 MPM and assuming a hurdle rate of a 10 percent IRR to the company. If the alternative regime is above zero percent, then it represents fewer commercial successes compared to a regime with no royalties. If it is less than zero, it means more commercial successes.

178. The impact of different royalty regimes is only noticeable in the scenarios where no onshore concentration has occurred. In the base (not concentrated) scenario, up to 2.8 percent of the 500 model iterations would fail to meet the 10 percent commercial threshold if the Hybrid 2 royalty option were applied. This would increase to seven percent of the 500 model iterations in the high-grade (not concentrated) scenario.

Figure 17: Reduction in commercial success rate relative to status quo (SMS)

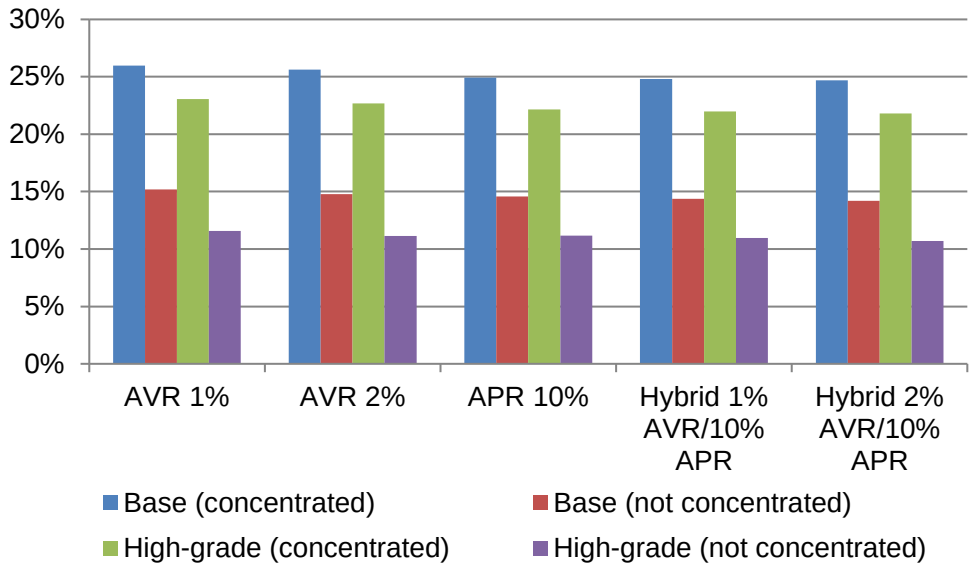


179. Based on the results shown above, AVR 1 has been ranked best, AVR 2 second, the pure APR third, Hybrid 1 fourth, and Hybrid 2 fifth.

Objective 3: Appropriate risk-sharing between private investment and the Crown

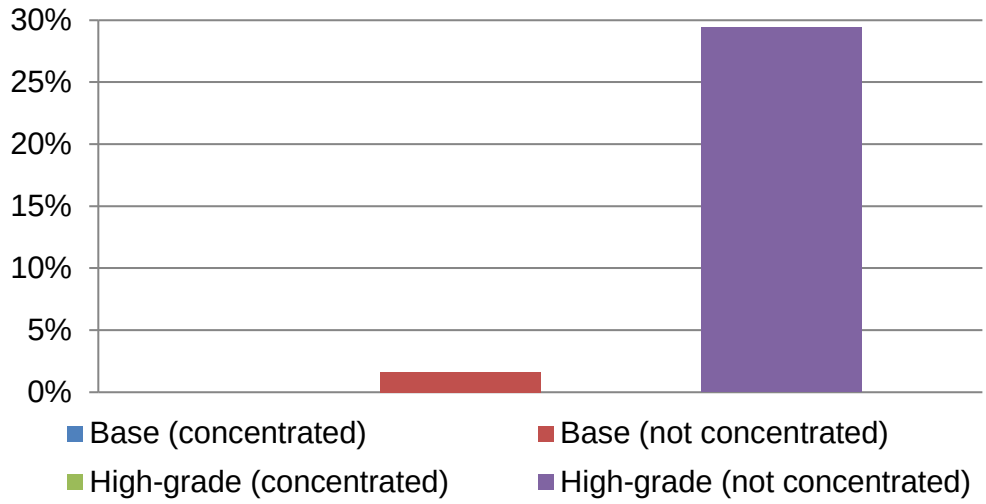
180. Under the base-case assumptions, both scenarios that involve concentration would be highly profitable. The scenarios that do not involve any concentration would be marginal (that is, the internal rate of return is between 10 and 15 percent), but it has been assumed that they would still proceed to development.

Figure 18: Internal rates of return to operator (SMS)



181. Figure 19 below shows the proportion of developments that would not be developed, before a royalty is applied, out of 500 simulations modelled and using a 10 percent hurdle rate. Both scenarios that involve concentration would meet the 10 percent threshold in all iterations. In the base (not concentrated) scenario, 1.6 percent of the 500 model simulations would be uneconomic before a royalty is applied. This increases to 29.4 percent in the high-grade (not concentrated) scenario.

Figure 19: Probability of unsuccessful mine development with no royalty (SMS)



Note: Both concentrated scenarios are zero

Table 30: Net present value to operator (NZ$ million) for future mine developments (SMS)

	Base (not concentrated)			Base (concentrated)		
	P90	P50	P10	P90	P50	P10
Status quo - 1% AVR / 5% APR	69.4	215.2	361.4	730.9	947.5	1,239.0
1% AVR	80.8	229.8	379.7	768.8	990.2	1,294.5
2% AVR	63.6	210.9	359.1	741.8	963.5	1,258.0
10% APR	57.2	196.3	336.5	682.4	889.1	1,163.2
Hybrid 1%AVR / 10% APR	48.9	188.6	329.4	675.4	883.4	1,156.9
Hybrid 2%AVR / 10% APR	39.2	180.7	322.2	670.4	876.2	1,150.9
1% AVR versus status quo	11.4	14.6	18.2	37.9	42.7	55.5
2% AVR versus status quo	-5.8	-4.4	-2.3	10.9	15.9	19.0
10% APR versus status quo	-12.2	-19.0	-25.0	-48.5	-58.4	-75.8
Hybrid 1%AVR / 10%APR versus status quo	-20.5	-26.6	-32.1	-55.5	-64.1	-82.2
Hybrid 2%AVR / 10%APR versus status quo	-30.2	-34.5	-39.2	-60.5	-71.3	-88.1
	High-grade (not concentrated)			High-grade (concentrated)		
	P90	P50	P10	P90	P50	P10
Status quo - 1% AVR / 5% APR	-74.4	35.4	148.2	374.6	536.5	720.3
1% AVR	-69.6	42.1	157.0	395.5	561.7	750.4
2% AVR	-82.3	28.5	141.2	376.7	542.7	728.6
10% APR	-76.4	29.0	136.0	347.4	503.6	676.4
Hybrid 1%AVR / 10% APR	-83.4	22.9	129.5	341.3	496.8	671.3
Hybrid 2%AVR / 10% APR	-91.3	15.6	123.6	335.0	489.9	663.1
1% AVR versus status quo	4.8	6.7	8.7	20.9	25.2	30.1
2% AVR versus status quo	-7.9	-6.9	-7.0	2.1	6.2	8.3
10% APR versus status quo	-2.0	-6.4	-12.2	-27.2	-32.9	-43.9
Hybrid 1%AVR / 10%APR versus status quo	-9.0	-12.5	-18.7	-33.3	-39.6	-49.0
Hybrid 2%AVR / 10%APR versus status quo	-16.9	-19.8	-24.7	-39.6	-46.6	-57.2

182. Table 30 above shows that only the AVR 1 royalty option would offer upside to the miner under each P90 scenario, relative to the 1996 MPM royalty regime. All of the other royalty options would offer downside to the miner in the P90 case. With the exception of high-grade (not concentrated) scenario, which would be uneconomic in the P90 case before a royalty is applied, the NPV to the operator in the P90 case would range from $64 million to $769 million. The Ministry would expect that the mine developments would proceed.

183. On balance, the pure APR has been ranked best in relation to the “appropriate risk-sharing” objective, Hybrid 1 second, Hybrid 2 third, AVR 2 fourth and AVR 1 fifth.

Recommendations: SMS

184. For SMS, the Ministry recommends Hybrid 2 option – that is the higher the higher of a two percent AVR and a 10 percent APR.

185. The Ministry considers that this option will provide fair returns to the Crown, will provide appropriate risk-sharing between the Crown and private investment, and will have a negligible impact on the number of companies that decide to proceed with a mine development.

Appendix 8: Types of royalty regimes

186. A royalty is a payment by a miner to the owner of the mineral resource as compensation to the owner for granting the miner the right to remove the minerals and to develop the resource for the miner's own benefit.

187. Royalties may be divided into the following types:

    a. unit-based royalty

    b. value-based royalty

    c. sector-specific profits tax (such as an accounting profits royalty)

    d. resource rent tax

    e. hybrid royalty.

Unit-based royalties

188. Unit-based royalties are levied per unit volume or weight. They impose burdens that vary in inverse relation to changes in market price. For that reason they are considered to be economically inefficient.

189. The key advantages of unit/value-based royalties are that they ensure a guaranteed returns to the State as soon as production begins, thereby meeting a key aspect of the "fair return" objective. Because they are related to production, they can also be estimated with a reasonable degree of predictability thereby meeting the "administrative simplicity" objective.

190. The main disadvantage of unit/value-based royalties is that they are relatively inefficient. Because they are payable regardless of whether the project is profitable, a unit-based/value-based royalty will, at a certain level of royalty, make a project that is economic before the application of a royalty uneconomic after the royalty is applied. Due to their regressive nature, these types of royalties will act as a deterrent for investment. More broadly, unit-based royalties distort investment decisions, encourage uneconomic choices, and reduce the economic life of a project.

191. For these reasons, unit-based royalties tend to be applied at low rates to bulk, low-value commodities.

Value-based royalties

192. A value-based - or "ad-valorem" - royalty is levied on the value of the mineral sold. The key difference compared to unit-based royalties is that value-based royalties fluctuate in line with commodity prices.

193. Like unit-based royalties, value-based royalties provide guaranteed returns to the State as soon as production begins and they are also relatively simple to administer (although complications can arise depending on how "value" is defined). Value-based royalties are also relatively inefficient, although more efficient than unit-based royalties. Deductions of transport, insurance and other marketing costs are sometimes allowed in order to approximate an ex-mine value base.

Sector-specific profits tax (accounting profits royalty)

194. Sector-specific profits taxes, such as accounting profits royalties, allow for the deduction of a range of costs associated with developing a project. These exploration and development costs are typically carried forward, thus reducing accounting profits over the initial period of production. This will delay early returns to the State from production. The government can also lose royalty payments at the end of a project's life as a result of high decommissioning costs where losses carried back decreases the reported accounting profits. However, unlike the ad valorem and unit-based royalties, which tend to be regressive at the beginning and end of a mine's life, an accounting profits royalty is neutral. All other things being equal, this will extend the economic life of a mine.

195. Sector-specific profits taxes are more complex to administer than net sales value-based or unit-based royalties, but this can be mitigated by aligning them with good accounting practices and corporate tax returns.

Resource rent tax/royalty

196. Under a resource rent approach, a project is effectively granted a royalty holiday in anticipation of relatively high governmental returns later in mine life. The payment of the resource rent is deferred until all expenditures have been recovered and the project has yielded a predefined target return expressed as an uplift rate or rate of return. A high marginal royalty is then applied to all subsequent operating revenue. This ensures a fair return for the State on the profit made from the project and ties the State's return more directly to the project's profitability. The resource rent tax has the same advantage as the accounting profits royalty in that it does not distort marginal decisions, but it will further delay the start of royalty payments.

197. Resource rent taxes/royalties are neutral, at least in theory, in relation to investment decisions. This, however, depends on how close the target rate is to the investor's discount rate, which in turn reflects the project risk and the investor's corporate profile. The risk-free interest rate is typically assumed to be the same as the long-term government bond rate. In principle, if the threshold rate for a given project is set at the investor's discount rate (comprising the risk-free interest rate plus an appropriate risk premium), the remaining net cash flow represents the economic rent of the project.

198. The government shares in more of the downside risk under a resource rent, as it is possible that a mine will produce but never reach the threshold rate, in which case, the government will not receive any return on its resource. This can be avoided by combining a resource rent with a value-based royalty.

199. Resource rent taxes/royalties are more difficult to assess and monitor than other rent collection methods as there is more scope for mining companies to avoid their royalty liability by spending excess amounts on exploration and development (known as “gold-plating” projects). This has the impact of reducing their rate of return. Gold-plating arises when a project’s required rate of return is lower than the annual uplift factor applied to the resource rental tax. The miner then has an incentive to over-invest in the project in order to earn the uplift factor, which in effect is a rate of return on the miner’s tax asset. This problem can be minimised by selecting an uplift factor that reflects the true financial risk of the tax asset. However, as hurdle rates of return on investment are highly project specific and uplift factors are necessarily an industry-wide approximation set at the national level, gold-plating cannot be entirely eliminated unless the uplift factor is set very conservatively. Gold-plating can also be reduced through stringent monitoring and effective enforcement mechanisms.

Glossary

The Act	The Crown Minerals Act 1991
APR	Accounting profits royalty. The APR is a mechanism whereby the resource owner receives a share of the profits once all significant costs have been recovered by the producer. It is payable on the net accumulated accounting profit of production from a project field. It takes into account both prices received for products and the costs of extracting, processing and selling those products up to the point of sale. The APR under the 1996 Minerals Programme for Minerals (MPM) is 5 percent of accounting profits from a mining permit.
AVR	Ad valorem royalty. The AVR is a royalty payable on the basis of either a sales price received or, where there has been no sale or no arm's length sale, the deemed sales price. Under the 2008 MPM, AVR is one percent of the net sales revenues from a gold, silver of platinum group element permit if the net sales are $1.5 million or less, or two percent if the net sales are higher than $1.5 million. In the 1996 Minerals Programme for Minerals there was a one percent AVR applied across all minerals.
IRD	Inland revenue department
IRR	Internal rate of return
MPM	Minerals Programme for Minerals
NPV	Net present value
PGE	Platinum group elements
SMS	Seafloor massive sulphides. SMS are undersea mineral deposits of volcanic origin. They typically contain multiple minerals, including gold, silver, copper, zinc and barium.
UCG	Underground coal gasification. UCG is a process whereby coal is converted into gas at the site of the coal deposit.