



## **Options for Used Oil Recovery in New Zealand**

### **Appendix D: COST BENEFIT ANALYSIS**

---

In order to help assess the attractiveness of the options for used oil collection, it is useful to compare the cost structures of the various regimes, along with their projected oil recovery rates. This allows us to form a view about the costs and benefits of moving from the status quo to a centralised collection or stewardship scheme.

In this appendix, we develop projections for the costs and recovery rates associated with each of the options (ie status quo, stewardship and centralised collection) and conduct a form of cost benefit analysis over a period of 20 years for each of the three regimes.<sup>1</sup>

Throughout this appendix, we assume the following:

- The recovery rate under the status quo is 60%, at least initially<sup>2</sup>.
- The recovery rate under the alternative regimes would initially be the same as under the status quo, but gradually increase over time.
- 65 million litres of lubricating oil is currently consumed in New Zealand<sup>3</sup>; and,
- 50% of the volume of lubricating oil consumed is potentially recoverable. (Given the annual consumption figure above, this yields a potentially recoverable volume of 32.5 million litres.<sup>4</sup>)

#### **D.1 THE STATUS QUO**

For the analysis of the status quo, we categorise the costs incurred into three main groupings:

- Set-up and maintenance of public collection sites;
- Collection and transportation of used oil to end-market (e.g. for burning in cement kilns at Milburn); and,
- Administration costs.

---

<sup>1</sup> The analysis is not cost-benefit analysis in its strict sense in that we have not attempted to monetise the value of retrieved oil and subsequently calculate a net present value or internal rate of return. Rather, the analysis provides a comparative assessment of the present value of the cost of recovering a litre of used oil, along with the total volume of oil recovered. As such it still allows us to provide a *comparative* assessment of the economics of the various alternatives.

<sup>2</sup> Two alternative scenarios are presented as to what might happen in the future under the status quo.

<sup>3</sup> Used Oil Recovery, Reuse and Disposal in New Zealand: Issues and Options (2000), Ministry for the Environment.

<sup>4</sup> Note, there is conflicting data about the percentage of oil that is potentially recoverable. Worley (1999) estimates that on average 62.5% is recoverable, while the Ministry's Oil Discussion Document (Used Oil Recovery, Reuse and Disposal in New Zealand: Issues and Options (2000)) estimates the recoverable proportion to be 50%.

### D.1.1 Set up and maintenance of public collection sites

Public collection sites have already been established, albeit to varying degrees of coverage. Under the status quo, we do not anticipate any further investment in public collection sites. Hence, for the purposes of the analysis, we assume that the cost of investment in public collection sites is sunk and that there are no further set-up costs<sup>5</sup>.

The cost of maintaining storage units (such as forecourt igloos) is negligible in comparison with transportation and disposal costs. Maintenance costs associated with public collection points are assumed to be NZ\$50,000 per annum (the same as is estimated for the centralised collection scheme<sup>6</sup>).

(Note, however, that this may be an over-estimate of the maintenance costs, in that under the status quo, collection sites are typically large plastic igloos whose associated costs of maintenance would be less than those for a steel collection tank<sup>7</sup>.)

### D.1.2 Collection and transportation costs

Transportation and collection<sup>8</sup> costs comprise the bulk of the total cost. The average cost of collecting and transporting used oil is currently around 17 cents per litre, varying between about 15 cents per litre in populous areas to 20 cents per litre in rural areas<sup>9</sup>. Both Mobil and the Used Oil Recovery Group (UORP) report similar costs of transportation and collection. For the purposes of the analysis, we assume a uniform average cost of 17 cents per litre.

Under the current scheme there is no centralised coordination of collection, public education or environmental quality assurance. The UORP is simply responsible for the set-up and maintenance of collection sites, and the management of collection contracts with various transporters and collectors. Administration costs under the current regime are thus very low in comparison to the transportation and collection. We assume that under the current scheme administration costs are roughly \$50,000 per annum<sup>10</sup>. The (annual) costs associated with the status quo are summarised in the table and figure below. Note that this represents the cost associated with recovering 19.5 million litres of oil per annum.

---

<sup>5</sup> Note that the approximate set-up cost of a plastic igloo is \$1200 per site (Source: Steve Fursdon, Mobil New Zealand).

<sup>6</sup> Under a ROSE type scheme, it is estimated that cost of maintaining equipment will be roughly \$50,000 per annum (source: Sarah Schiess, BP). For the purposes of this investigation we will assume that the same cost applies under the status quo also.

<sup>7</sup> It is envisaged that under a centralised collection regime, public collection sites would comprise steel tanks, similar to the ones used in South Africa.

<sup>8</sup> Note that the transportation and collection phase includes heating, dewatering and other pre-treatment of used oil.

<sup>9</sup> Ron Salter, Salter Cartage Limited.

<sup>10</sup> Administration costs are quite variable. Mobil estimates its current administration costs to be around \$30,000 (Source: Steve Fursdon, Mobil).

| Area in which cost is incurred                                    | Cost (per annum)  |
|---|---|
| Recovery Rate   | 60%   |
| Amount of Oil Recovered   | 19.5 million litres   |
| Maintenance of collection sites                                   | \$50,000  |
| Transportation and collection of oil assuming a 60% recovery rate | $\$0.17 * 32.5 \text{ million litres} * 60\% = \$3,315,000$ |
| Administration  | \$50,000  |
| <b>Total Cost</b>   | <b>\$3,415,000</b>  |

TABLE 1 : USED OIL RECOVERY COSTS UNDER THE STATUS QUO.

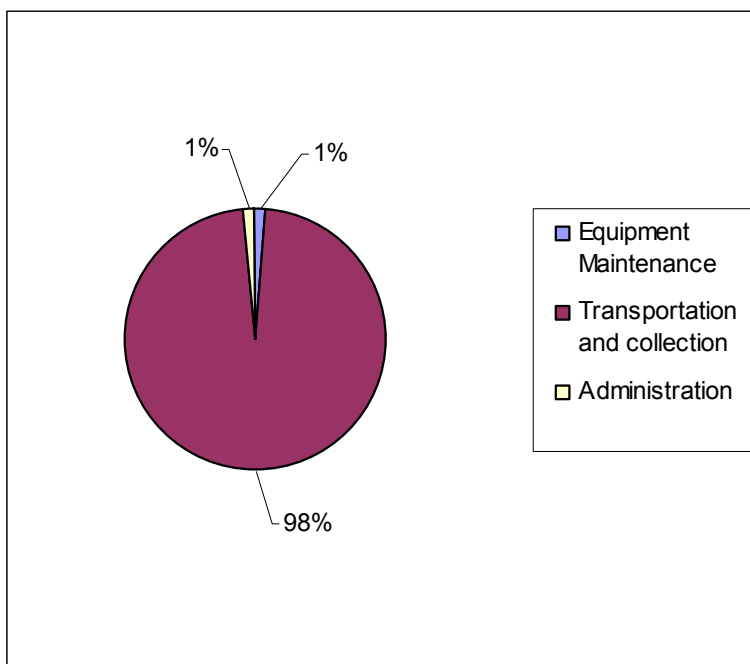


FIGURE 1 : BREAKDOWN OF COSTS UNDER THE STATUS QUO.

The cost structure described above assumes the current situation will continue. Some larger oil companies have threatened to remove forecourt igloos from service stations unless smaller oil companies contribute to the cost of used oil collection. If the status quo were retained it is possible that the existing infrastructure would decay leading to a decline in recovery rates. This scenario is investigated in more detail in the Cost Benefit Analysis section.

### D.1 STEWARDSHIP OBLIGATION

Under a stewardship regime the responsibility for collection rests with the retailer (or more specifically, the last seller). The costs associated with the regime can be categorised as follows:

- Set-up and maintenance of take-back facilities;
- Transportation and collection of used oil;
- Administration; and,
- Public Education.

### D.2.1 Set-up and Maintenance of Collection Facilities

It is assumed that under a stewardship obligation retailers would provide a take-back facility in the form of a plastic igloo. (While larger oil companies are being encouraged to “update” their facilities to steel tanks if they remodel, plastic igloos are currently still deemed to be acceptable as a take-back receptacle<sup>11</sup>.)

Figure 2 provides an illustration of the number of retail outlets in New Zealand that sell lubricating oil<sup>12</sup>. There are around 3,000 retailers (of lubricating oil) nationwide. At a cost of approximately \$1,200 for setting up a plastic igloo, and assuming each retailer elects to provide a takeback facility (rather than contracting with another provider) this yields a total set-up cost of \$3.6 million.

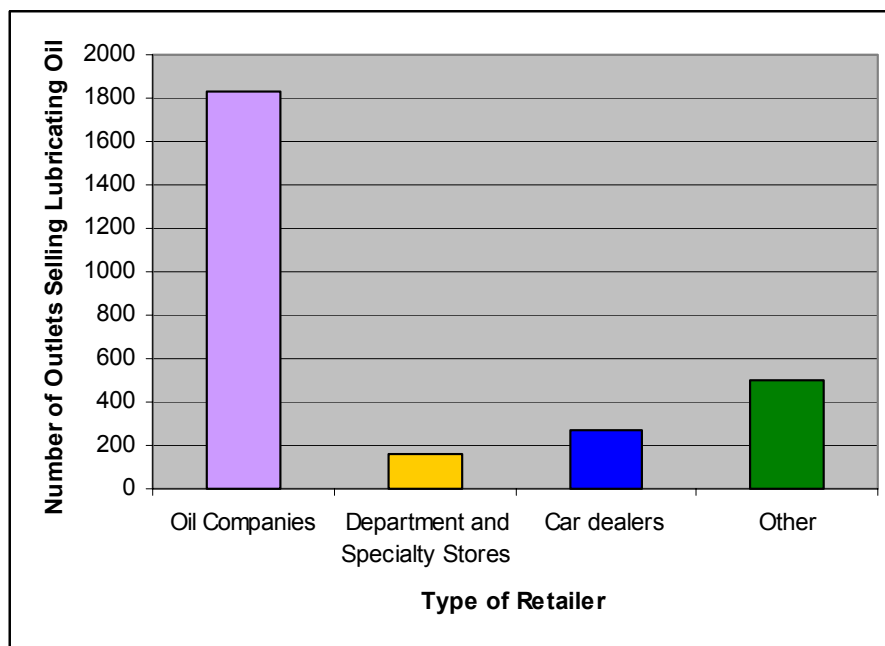


FIGURE 2: RETAILERS OF LUBRICATING OIL IN NEW ZEALAND.

In addition to the 3,000 retailers above, there are around 4,000 small garages and workshops operating in New Zealand<sup>13</sup>. As indicated, these small operators will not have to meet the costs of the return of the oil they use in the course of their vehicle servicing and repair operations; the costs of collection will be covered by their suppliers.

<sup>11</sup> Ian Murray, Occupational Health and Safety Office.

<sup>12</sup> Figures on number of retail outlets was provided by Ashley Robinson, Ministry for the Environment. Note that these figures are rough estimates.

<sup>13</sup> Ashley Robinson, Ministry for the Environment.

However, most of these smaller operators also sell motor oil, albeit in small quantities. We suspect that it may not be cost effective for these players to provide a take-back service for their consumers, in that they may have difficulty recovering their costs, given the small quantity of oil that they sell. It is likely that under a stewardship scheme these garages and workshops will make arrangements with other operators to make use of their take-back facilities. Thus, for the purposes of this analysis, we assume that there are only 3,000 retailers who are likely to provide the take-back service (with the smaller retailers either dropping out of the market or negotiating with other operators for a take-back facility).

Costs of maintaining the plastic igloos will be negligible in comparison to the transportation and collection costs. For the purposes of this analysis, we assume that the total cost of maintenance under the stewardship regime will be the same as that under the status quo (ie \$50,000 per annum).

### **D.2.2 Transportation and Collection of Used Oil**

As with all of the regimes considered, the transportation and collection costs comprise the bulk of total cost. We assume that the retailers will continue to negotiate contracts with the same companies which serve the current network and thus that the average cost of transporting one litre of used oil will be the same as the cost under the current recovery regime (ie 17 cents per litre on average).

(Note that, as there is no centralised coordination of collection effort, we have not factored in any cost reduction over time associated with economies of scale.)

### **D.2.3 Administration**

Under a stewardship regime, administration costs would consist of the training of staff to monitor the take-back facility, as well as negotiating collection contracts with the various transporters and collectors. Although the total cost of administration (for all retailers) will be quite large, administration costs incurred by the individual retailer will be negligible.

Obtaining information about the time and money spent (in terms of administrative costs) on a forecourt igloo is quite difficult. For the purposes of this study, we assume that each retailer will incur an annual cost of \$1,000 for administrative purposes. Assuming a total of 3,000 retailers, this yields a total administration cost of \$3 million.

### **D.2.4 Public Education**

The success of a stewardship regime will depend on public awareness about the hazards of used oil. To this end, it will be necessary to provide consumers with educational material (in the form of pamphlets) at point of sale. The cost can either be covered by the retailers themselves, or by an appropriate Government department (such as the Ministry).

For the purposes of this study we will assume that the annual cost of providing public education is \$15,000<sup>14</sup>.

---

<sup>14</sup> The annual cost of designing and distributing educational pamphlets nationwide would be roughly \$15,000 (source: Alison Handley, Ministry for the Environment). We also assume that the cost of public education will be substantially less under a stewardship regime compared to a centralised collection scheme. The reason is that any educational campaigns undertaken by the centralised collection agency will most likely be more comprehensive than that under a stewardship regime.

It is likely that educational pamphlets would need to be supplemented with public education initiatives. However, for the purposes of this analysis we have assumed that public education costs under a stewardship regime comprise only the cost of producing and distributing educational pamphlets at point of sale.

### D.2.5 Total Cost

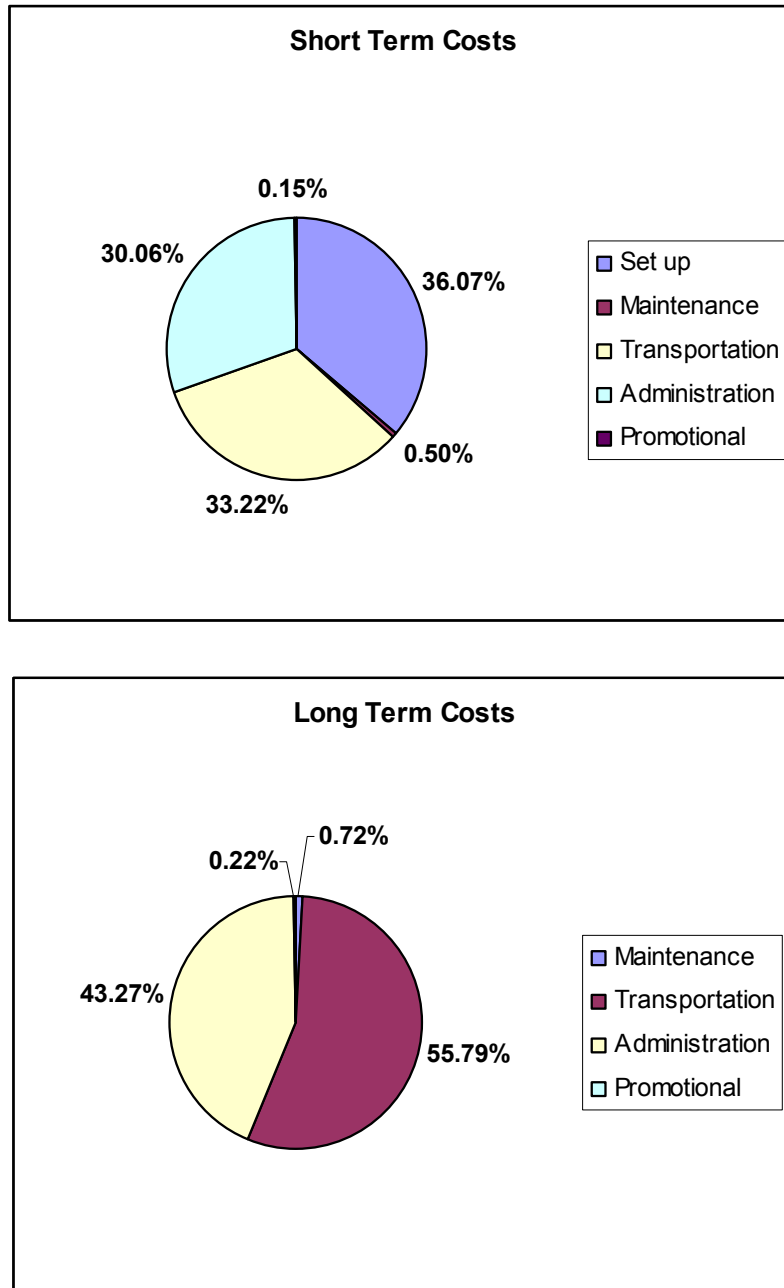
Assume that the initial recovery rate of a centralised collection regime is the same as that under the status quo (60%). The initial targeted amount for recovery will be 19.5 million litres. As an illustrative example, further assume that in the long term the recovery rate increases to 70%.<sup>15</sup> Also assume that total oil consumption is still 65 million litres in the long term<sup>16</sup>. The expected amount of oil recovered in the long term is then 23 million litres. The costs associated with setting up and operating a “take-back” regime are summarised in Table 2:

| Area in which cost is incurred  | Annual Cost (Short term) | Annual Cost (Long term) |
|---|--------------------------|-------------------------|
| Recovery Rate   | 60%                      | 70%                     |
| Amount of Oil Recovered Assuming Constant Oil Consumption                             | 19.5 million litres      | 23 million litres       |
| Initial set-up cost (assuming an average cost of \$10,000 per site and 20 nationwide) | \$3,600,000              | \$0                     |
| Maintenance of equipment  | \$50,000                 | \$50,000                |
| Transportation and collection costs   | \$3,315,000              | \$3,867,500             |
| Administration  | \$3,000,000              | \$3,000,000             |
| Promotional activities and public education   | \$15,000                 | \$15,000                |
| <b>Total Cost</b>   | <b>\$9,980,000</b>       | <b>\$6,932,500</b>      |

TABLE 2 : USED OIL RECOVERY COSTS UNDER A STEWARDSHIP OBLIGATION

<sup>15</sup> For the reasons outlined in the body of the report, we consider it reasonable to assume some improvement in the recovery rate vis-à-vis the status quo.

<sup>16</sup> For the moment, we assume that there is no growth in oil consumption. When performing the cost benefit analysis, however, we examine scenarios where oil consumption increases and decreases.



**FIGURE 3: BREAKDOWN OF COSTS UNDER STEWARDSHIP OBLIGATION.**

Note that, under the stewardship regime, set-up costs comprise a large portion of total cost. Under a take-back regime, retailers are required to either provide a take-back facility or negotiate for a facility in close proximity of their business. Although the cost of setting up a plastic igloo is quite low in comparison to setting up a steel tank, there are a large number of retailers of motor oil and the total set-up cost will be considerably higher than under a centralised collection regime.

Similarly, administration costs also comprise a large proportion of total cost due to the large number of motor oil retailers throughout the country.

Also note that the transportation and collection costs do not decrease in the long term.

## **D.2.6 Funding a Stewardship Regime**

Under the “take-back” scheme it is the retailers’ responsibility to cover costs incurred from providing a take-back facility, as well as costs of collecting and transporting the used oil. These costs can be covered in two ways: by earning revenues from the sale of used oil; and through an environmental handling charge (EHC) or a levy imposed by the retailer at point of sale. While this study does not determine a levy for the stewardship regime, the following points are noted.

While sales of used oil to refineries for subsequent sale to the end-market is very common in Canadian provinces like British Columbia, this may not be applicable in New Zealand. Under the current regime, Milburn Cement is the main destination for the UORP’s used oil (predominantly due to the fact that they operate the only high temperature oil burners in New Zealand). Milburn Cement has an agreement with the UORP whereby they take the used oil at no charge/payment. Revenues earned from used oil under the status quo predominantly comprise “unofficial” transactions between small garages and workshops and local tomato growers for instance. However, these end-market destinations are most unlikely to meet the requisite environmental standards (many local tomato growers burn their oil at low temperatures). Consequently, we have not recognised any revenues that might be earned from these sources. Thus we assume that, at least in the short term, retailers will be unable to earn revenues from the sale of used oil.

This leaves retailers with only one option to cover their costs, that is, through an EHC or a levy imposed at point of sale. This charge should be just enough to cover the retailers’ costs. The magnitude of this charge will vary from retailer to retailer, and will depend on the amount of lubricating oil that the retailer sells. For example, a Shell service station will most likely sell large quantities of oil, and their charge will be substantially lower than a small rural garage that sells a few litres a year.

At first glance, such a scheme appears to create a very uneven playing field, with larger retailers being able to cover their costs easily, and smaller retailers struggling. However, in reality, it is likely that retailers who sell negligible quantities of motor oil will decide to drop out of the market. Furthermore, retailers will also be given the choice of negotiating with an outside party to provide a take-back facility (within an adequate distance of their business).

## **D.1 CENTRALISED COLLECTION REGIME**

Under a centralised collection regime, all costs will be incurred by the agency responsible for the recovery of the used oil. These costs will be incurred in the following areas:

- Set-up and maintenance of collection sites;
- Transportation and collection of used oil;
- Administration;
- Promotional activities and public education.

In the following sections the costs associated with the above are analysed in more detail.

### **D.3.1 Set-up and Maintenance of Collection Sites**

There will be a large initial set-up cost associated with the construction of new collection sites. The type of collection facilities under a centralised collection scheme will depend to a certain extent on the implications of the HSNO Act for the management of used oil. At

this stage, however, it is envisaged that collection sites under a centralised collection scheme would comprise steel tanks as opposed to the large plastic igloos that are used under the status quo or that might appear under the stewardship regime. There are potentially two types of collection facilities:

- *Uncontrolled Sites*: These sites will most likely comprise just a collection facility that consumers can use to dispose of their used oil.
- *Controlled Sites*: These sites will have fully trained personnel checking that the used oil is disposed of correctly at the collection sites. The costs associated with controlled sites will obviously be higher than those associated with the uncontrolled sites, as it includes the cost of training and hiring personnel to ensure that the used oil is disposed of correctly.

It is anticipated that steel tanks will cost anywhere between \$5,000 to \$20,000 per site to set up<sup>17</sup>. For the purposes of the cost benefit analysis, we assume an average cost of \$10,000 per site.

In determining the number of collection sites, along with their respective locations, accessibility to the end consumer is the highest priority. While it is not possible to provide a precise estimate of the number of collection sites envisaged under a centralised collection scheme, it is possible to contrive a reasonable approximation sufficient for the purposes of this analysis.

Figure 4 is a map of New Zealand and contains all the major cities, as well as smaller rural towns. Assuming that there will be at least one collection site in small towns and about three to five in a more populous areas, a brief glance at the map suggests that anything less than 200 sites would not ensure accessibility to all consumers. For the purposes of the cost benefit analysis we assume that under a centralised collection regime there will be 200 sites nationwide, with an average set-up cost of \$10,000, yielding a total set-up cost of \$2 million.

---

<sup>17</sup> Steve Fursdon, Mobil New Zealand.



FIGURE 4: MAP OF NEW ZEALAND.

### D.3.2 Transportation and Collection Costs

As mentioned earlier, the bulk of the costs for any used oil recovery regime pertain to those associated with collecting, transporting and pre-treating the oil for subsequent recycling. In the short-term, transportation costs under a centralised collection scheme will be comparable to those under the status quo (ie ranging between 15 and 20 cents per litre, with an average cost of 17 cents per litre). In the long-term, however, as the recovery rate improves and larger amounts of used oil are collected, these transportation costs will gradually decrease to around 10 cents per litre due to economies of scale<sup>18</sup>.

### D.3.3 Administration Costs

The administrative costs of the collection agency would include:

- General operating costs and overheads;
- Third party external auditors; and
- Engagement of environmental and engineering consultants.

Administrative costs are estimated to be in the order of \$200,000 per annum<sup>19</sup>.

<sup>18</sup> Sarah Schiess, BP.

<sup>19</sup> Sarah Schiess, BP.

### D.3.4 Promotional Costs

While a centralised collection agency will contribute to an improved recovery rate via centralised coordination, public education will still play a crucial role in ensuring the success of the scheme. To this end, promotional activities aimed at improving the public's understanding of the hazards of unsafe disposal of used oil will play a significant role in complementing the collection efforts.

Promotional activities will typically take the form of public awareness campaigns coupled with educational pamphlets (for pick up at retail outlets, for example). It is estimated that costs pertaining to promotions and public education will be approximately \$100,000 per annum<sup>20</sup>.

### D.3.5 Total Cost

Assume that the initial recovery rate of a centralised collection regime is the same as that under the status quo (60 %). The initial targeted amount for recovery will be 19.5 million litres. As an illustrative example, further assume that in the long term the recovery rate increases to 85%<sup>21</sup>. Also assume that total oil consumption is still 65 million litres in the long term. The expected amount of oil recovered in the long term is then 26 million litres. The costs associated with setting up and running a centralised collection agency is summarised in Table 3:

| Area in which cost is incurred   | Annual Cost (Short term) | Annual Cost (Long term) |
|--|--------------------------|-------------------------|
| Recovery Rate  | 60%                      | 85%                     |
| Amount of Oil Recovered Assuming Constant Oil Consumption                              | 19.5 million litres      | 27.6 million litres     |
| Initial set-up cost (assuming an average cost of \$10,000 per site and 200 nationwide) | \$2,000,000              | \$0                     |
| Maintenance of equipment   | \$50,000                 | \$50,000                |
| Transportation and collection costs  | \$3,315,000              | \$2,762,500             |
| Administration   | \$200,000                | \$200,000               |
| Promotional activities and public education  | \$100,000                | \$100,000               |
| <b>Total Cost</b>  | <b>\$5,665,000</b>       | <b>\$3,112,500</b>      |

TABLE 3 : COSTS OF CENTRALISED COLLECTION AGENCY

<sup>20</sup> Sarah Schiess, BP.

<sup>21</sup> For the reasons outlined in the body of the report, we assume that the recovery rate will be higher than either the status quo or the stewardship regime.

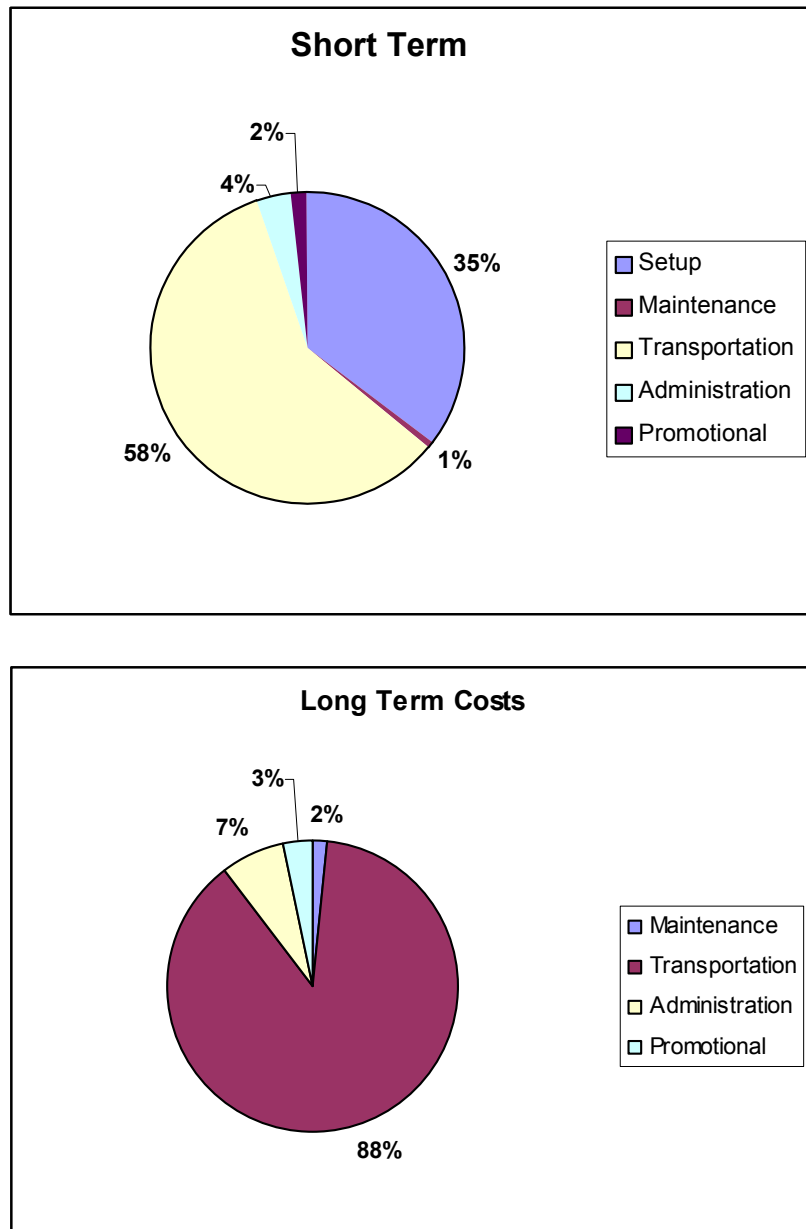


FIGURE 5: BREAKDOWN OF COSTS UNDER A CENTRALISED COLLECTION REGIME

### D.1 COST BENEFIT ANALYSIS

The sections above have summarised the cost structures of the three regimes under consideration. However, in order to form a view about the relative desirability of the options it is useful to take the analysis a step further and project their performance (in terms of the amount of oil recovered over time along with the cost (in terms present value dollars) of achieving the recovery levels.

To this end, a cost benefit analysis has been prepared. In order to perform the analysis the following parameters were assumed:

- 65 million litres of lubricating oil is consumed in New Zealand each year. Data on trends in oil consumption is scarce with conflicting claims. To this end, we examine two scenarios: one where oil consumption increases at an annual growth rate of 0.5%<sup>22</sup>; and one where oil consumption drops at a rate of 5% per annum<sup>23</sup>.
- Present values of total costs were evaluated using three discount rates: 5%, 10% and 20%;

The ratio of total oil recovered over the twenty-year period to the present value of total cost was then computed to give us some idea of the cost (in present value terms) per litre of oil recovered.

#### D.4.1 The Status Quo

There are two scenarios examined under the status quo:

- *Scenario 1:* The existing regime continues with used oil being collected by the UORP and Mobil only. Under this scenario we assume that the recovery rate will not improve over the twenty year period, ie it will remain at 60%;
- *Scenario 2:* Some of the larger oil companies withdraw their collection facilities. If this scenario arose then it is likely that the amount of oil recovered would decrease over the years. Furthermore it is likely that other oil companies may follow suit and withdraw their collection facilities as well. Hence it is reasonable to assume that the recovery rate will steadily deteriorate over the twenty-year period under this scenario. We assume an annual “deterioration” rate of 5%, ie each year the recovery rate drops by 5% from the year before. Thus if the current recovery rate is 60%, then we assume that the rate next year will be:

$$\frac{60}{100} \times \left( 1 - \frac{5}{100} \right) = 57\%.$$

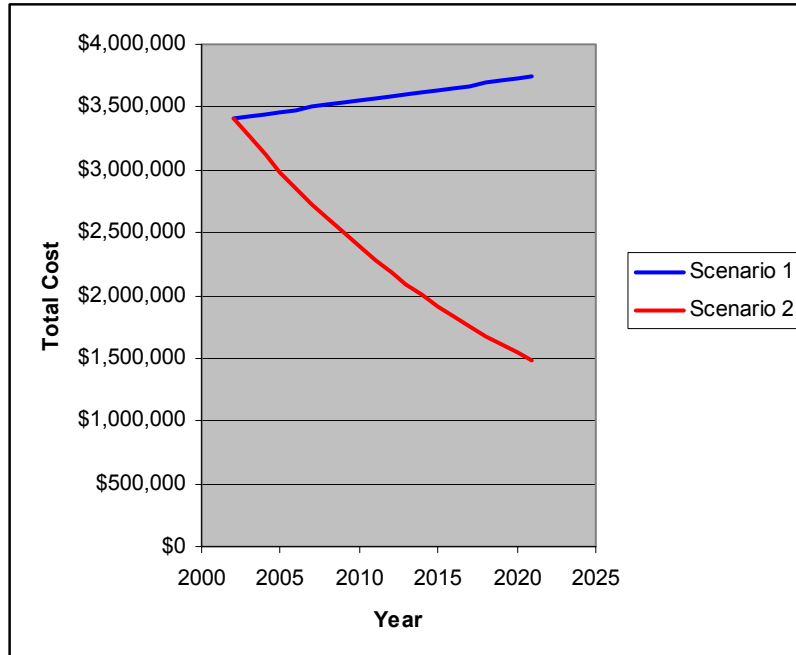
The second scenario is quite plausible, in that larger oil companies have stated that they will contribute no further and even withdraw their current facilities unless a level playing field is established.

Figure 6 illustrates the total cost under the status quo over a twenty-year period assuming that oil consumption increases.

---

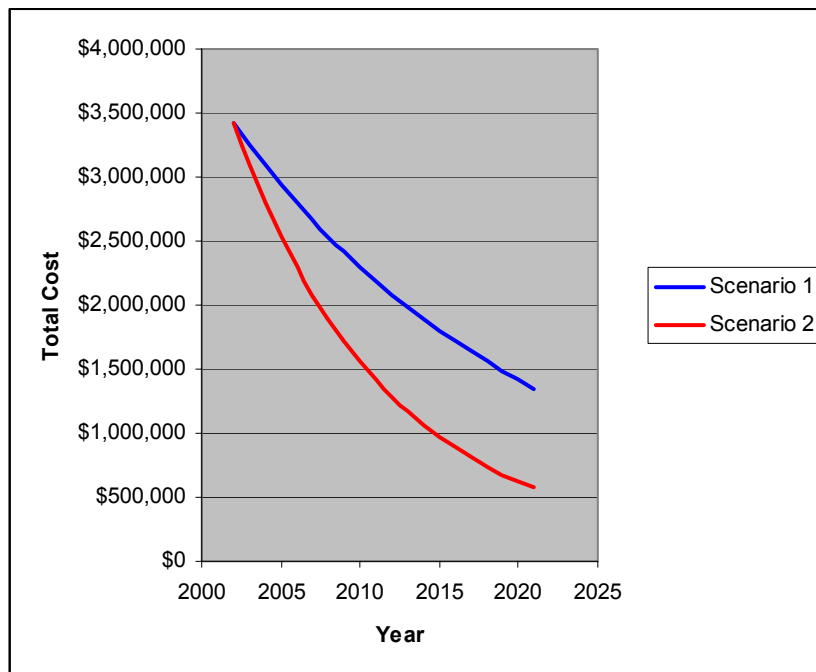
<sup>22</sup> Annual increase in consumption of motor oil is very low and ranges between 0 and 1 % (Source: Steve Fursdon, Mobil New Zealand). For the purposes of this study we will assume a growth rate of 0.5 %.

<sup>23</sup> There are reasons to believe that the market for lubricating oil may decline in the future. For example, cars now have longer service intervals. (source: Rob Wilby, BP).



**FIGURE 6: TOTAL COST VERSUS TIME UNDER STATUS QUO ASSUMING AN INCREASE IN OIL CONSUMPTION.**

The total cost under scenario 1 steadily rises with time, but there is no improvement in the recovery rate. Under the second scenario, total cost decreases with time, but this is attributable to the recovery rate deteriorating. As the recovery rate decreases, so does the amount of oil collected, implying lower costs for transportation and collection.



**FIGURE 7: TOTAL COST VERSUS TIME ASSUMING A DECREASE IN OIL CONSUMPTION.**

Assuming that oil consumption decreases at a steady rate of 5% per annum, we see that total cost decreases over time (since less oil is being collected).

| Discount Rate   | Scenario 1   |              |              | Scenario 2   |              |              |
|---|--------------|--------------|--------------|--------------|--------------|--------------|
|   | 5%           | 10%          | 20%          | 5%           | 10%          | 20%          |
| Present Value of Total Cost   | \$44,236,355 | \$30,015,132 | \$16,997,015 | \$30,853,888 | \$22,330,361 | \$13,864,127 |
| Total Oil Recovered (litres)  | 409,092,751  | 409,092,751  | 409,092,751  | 260,248,719  | 260,248,719  | 260,248,719  |
| Ratio of Total Oil Recovered to Present Value of Total Cost<br><br>(litres per dollar of present value of total cost) | 9.25         | 13.63        | 24.07        | 8.43         | 11.65        | 18.77        |

**TABLE 4 : PRESENT VALUE OF TOTAL COST UNDER THE STATUS QUO ASSUMING AN INCREASE IN OIL CONSUMPTION.**

Under scenario 1 (the status quo continues) the recovery rate remains 60% throughout the 20 years, and the increase in cost can be attributed to increased oil consumption. The present values for total cost are given in the first row of Table 4.

Under scenario 2 the total amount of oil recovered over the twenty year period is a lot less (due to a deteriorating recovery rate), and the present value of total cost is accordingly low.

The third row of the table gives us some indication of how much oil is collected for every dollar spent (in terms of present value). Hence, under a 10% discount rate and scenario 1, 9.25 litres of oil is collected for every \$1.00 of present value of total cost.

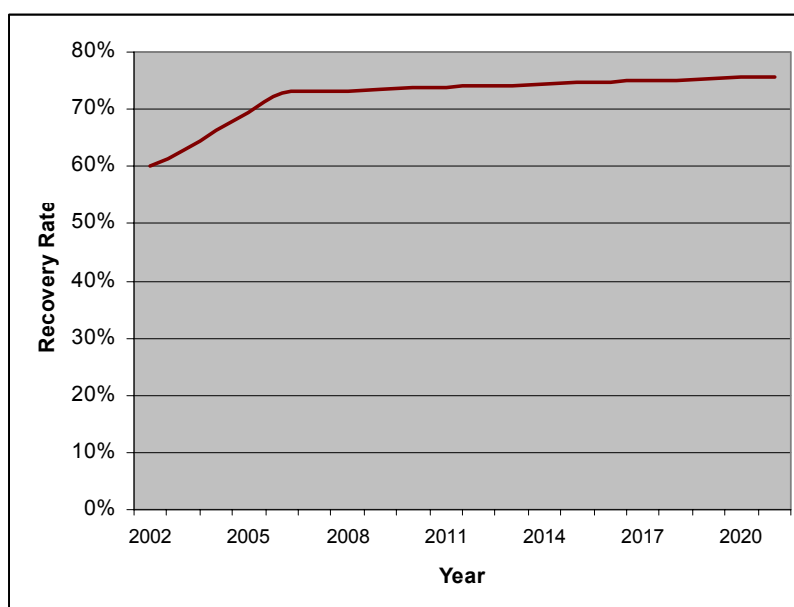
If we assume that oil consumption decreases over the twenty year period, then the present value of total cost under both scenarios are accordingly lower (if oil consumption drops then so does the amount of potentially recoverable oil, and hence the amount of oil collected is also lower, yielding lower transportation and collection costs). The ratio of oil recovered to present value of total cost is also lower under this scenario. (Refer Table 5).

| Discount Rate   | Scenario 1   |              |              | Scenario 2   |              |              |
|---|--------------|--------------|--------------|--------------|--------------|--------------|
|   | 5%           | 10%          | 20%          | 5%           | 10%          | 20%          |
| Present Value of Total Cost   | \$29,917,339 | \$21,773,721 | \$13,622,966 | \$22,632,244 | \$17,315,534 | \$11,592,463 |
| Total Oil Recovered (litres)  | 250,190,490  | 250,190,490  | 250,190,490  | 174,297,569  | 174,297,569  | 174,297,569  |
| Ratio of Total Oil Recovered to Present Value of Total Cost<br><br>(litres per dollar of present value of total cost) | 8.36         | 11.49        | 18.37        | 7.70         | 10.07        | 15.04        |

**TABLE 5 : PRESENT VALUE OF TOTAL COST UNDER THE STATUS QUO ASSUMING A DECREASE IN OIL CONSUMPTION.**

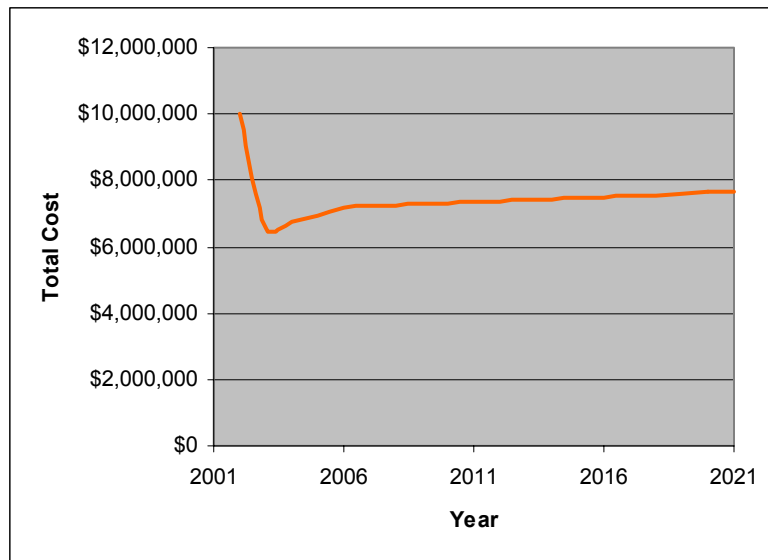
#### D.4.2 Stewardship Obligation

Under a stewardship obligation we assume that the initial recovery rate (at the onset of the twenty-year period) is 60%. Unlike the analysis for the status quo, however, we assume that the recovery rate will gradually increase. We assume that in the first five years the recovery rate will climb from 60% to 70% and plateau thereafter. Figure 8 illustrates our assumptions about the recovery rate under a stewardship regime. Note that as of 2007, the recovery rate rises but at a very slow rate. In particular, we have assumed this rate of increase to be 0.25%.



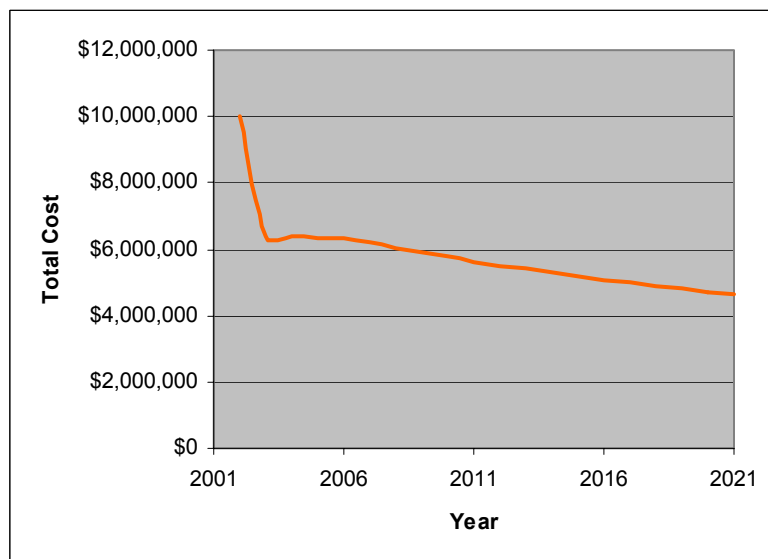
**FIGURE 8: ASSUMED PERFORMANCE OF RECOVERY RATE UNDER A STEWARDSHIP REGIME.**

In performing the cost benefit analysis, we have further assumed that under the take-back regime, retailers will not be able to reap the benefits of economies of scale, and that the average cost of transportation will remain constant at 17 cents per litre.



**FIGURE 9: TOTAL COST VERSUS TIME UNDER A STEWARDSHIP REGIME ASSUMING AN INCREASE IN OIL CONSUMPTION.**

Figure 9 illustrates trends in total cost over time for a stewardship regime assuming that oil consumption increases annually. There is an initial decrease in total cost once the initial set-up costs have been covered. Thereafter, the total cost gradually plateaus to between seven and eight million dollars per annum.



**FIGURE 10 : TOTAL COST VERSUS TIME ASSUMING A DECREASE IN OIL CONSUMPTION.**

Figure 10 illustrates trends in total cost for a stewardship regime assuming that oil consumption declines over time. Under this scenario total cost decreases over time. The initial cost (year 2001) is \$10 million compared to under \$5 million in 2021.

While this scheme is considerably more expensive than the status quo, it is useful to analyse this cost as a function of the amount of oil collected. Results of the cost benefit analysis for the scenario where oil consumption increases are illustrated in Table 6.

| Discount Rate  | 5%           | 10%          | 20%          |
|--|--------------|--------------|--------------|
| Present Value of Total Cost  | \$92,841,813 | \$63,615,060 | \$36,802,527 |
| Total Oil Recovered (litres)   | 494,166,891  | 494,166,891  | 494,166,891  |
| Ratio of Total Oil Recovered to Present Value of Total Cost (litres per dollar of present value of total cost) | 5.32         | 7.77         | 13.43        |

**TABLE 6 : PRESENT VALUE OF TOTAL COST UNDER A STEWARDSHIP REGIME ASSUMING AN INCREASE IN OIL CONSUMPTION.**

In comparing the stewardship regime to scenarios one and two of the status quo, we note that under the former an extra 90 and 230 million litres (respectively) of oil is collected (assuming an increase in oil consumption). We also note that the ratio of oil collected to present value of total cost is lower than both scenarios of the status quo.

Given that scenario 2 (under the status quo) is likely to occur unless all participants in the oil industry contribute to used oil collection, the stewardship regime is more attractive in terms of environmental performance, but carries a rather hefty cost with it.

Table 7 illustrates the results of the cost benefit analysis under the assumption that oil consumption drops.

| Discount Rate  | 5%           | 10%          | 20%          |
|--|--------------|--------------|--------------|
| Present Value of Total Cost  | \$75,191,759 | \$53,509,585 | \$32,712,952 |
| Total Oil Recovered (litres)   | 297,391,705  | 297,391,705  | 297,391,705  |
| Ratio of Present Value of Total Oil Recovered to Total Cost (litres per dollar of present value of total cost) | 3.96         | 5.56         | 9.09         |

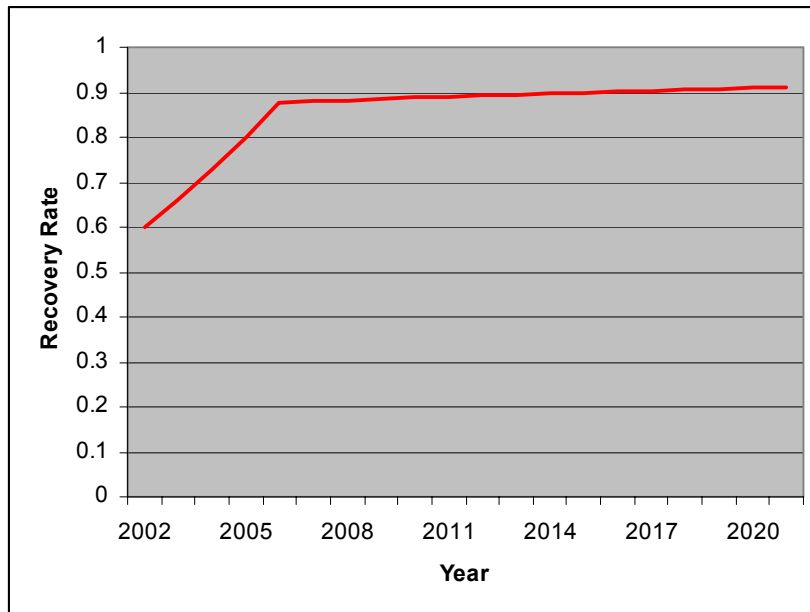
**TABLE 7 : PRESENT VALUE OF TOTAL COST UNDER A STEWARDSHIP REGIME ASSUMING A DECREASE IN OIL CONSUMPTION.**

Under this scenario, although the present value of total cost drops dramatically, there is also a decrease in the ratio of total oil recovered to present value of total cost.

#### **D.4.3 Centralised Collection Regime**

The research conducted in this report suggests that the centralised collection regime will most likely yield the best results in terms of improved recovery rates and economic

efficiency. To this end, we assume that under a centralised collection regime the recovery rate would climb from 60% to 85% and plateau thereafter, with an annual rate of increase of 0.25%. Figure 11 illustrates our assumptions about the performance of the recovery rate under a centralised collection regime.

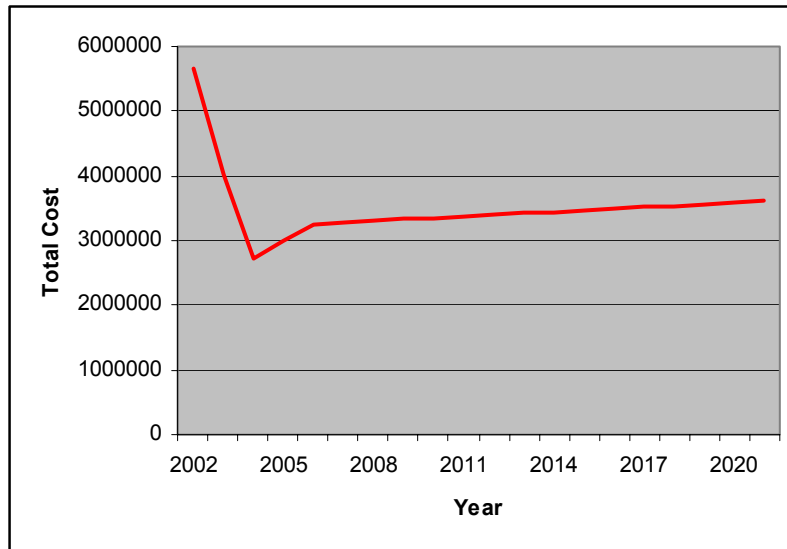


**FIGURE 11: PERFORMANCE OF RECOVERY RATE UNDER A CENTRALISED COLLECTION SCHEME.**

One of the advantages of this particular regime is that centralised coordination will ensure that network efficiencies are improved and that larger amounts of oil are collected over time as the recovery rate improves. Handling larger amounts of oil will lead to lower costs of transportation and collection due to economies of scale.

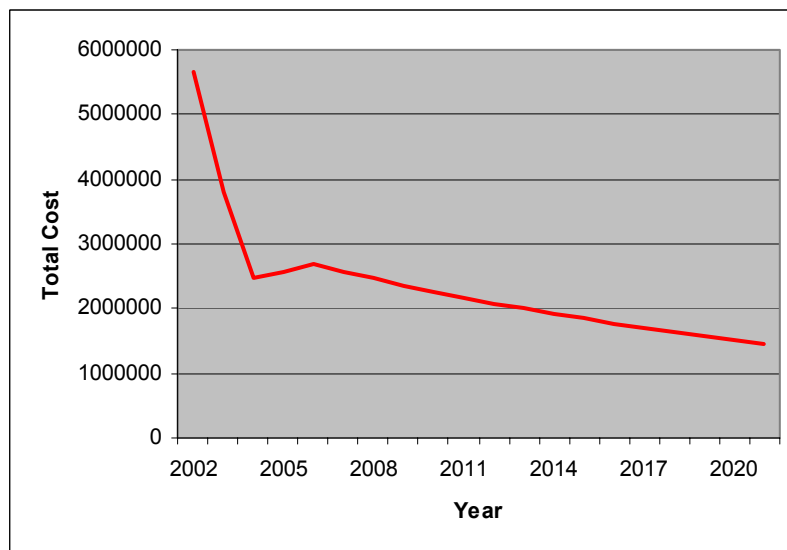
When the collection agency first starts operation the average cost of transporting and collecting one litre of used oil is set to be 17 cents. For the purposes of the cost benefit analysis, we have assumed that by the third year of operation, the amount of oil collected will be sufficient to induce economies of scale. Hence, from the third year of operation the average cost of transportation and collection is assumed to be 10 cents per litre.

Figure 12 illustrates the approximate total cost of a centralised collection agency over a twenty-year period assuming an increase in oil consumption.



**FIGURE 12 : TOTAL COST VERSUS TIME UNDER A CENTRALISED COLLECTION REGIME ASSUMING AN INCREASE IN OIL CONSUMPTION.**

Note that the cost decreases sharply in 2004 (when the agency is faced with lower transportation and collection costs). As the recovery rate improves and larger amounts of oil are collected, the costs gradually increase. From 2006 onwards, the total cost stays relatively constant, with increases in costs being attributable to larger amounts of oil collected.



**FIGURE 13 : TOTAL COST VERSUS TIME ASSUMING A DECREASE IN OIL CONSUMPTION.**

Assuming that oil consumption decreases over the 20 year period, we note from Figure 16, that after the initial sharp decrease in total cost, total cost continues to decrease.

The centralised collection agency can be funded by either a voluntary or compulsory levy at point of sale. The agency will be a non-profit one and the levy will be enough to cover the costs of operation. If the levy is compulsory, then it will be applied to all brands of lubricating oil sold in New Zealand. For the purposes of this study we have estimated the annual levy as follows:

$$\text{Levy} = \frac{\text{Total Annual Cost}}{\text{Total Lubricating Oil Sold}}$$

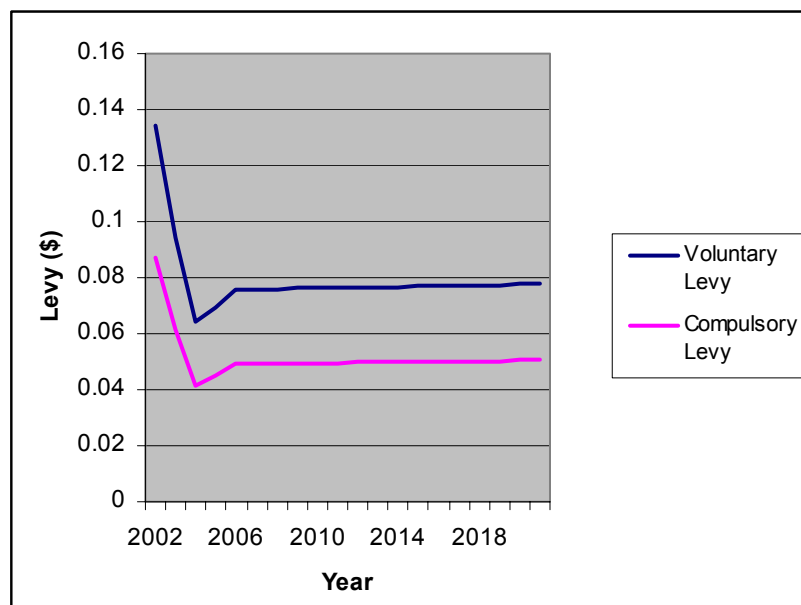
The levy will be modified each year to adjust for different costs. Hence, as costs decrease so will the levy.

If the levy is a voluntary one, it is likely that the smaller oil companies will not contribute, and that the cost will be shared by fewer participants. Accordingly, the levy used to fund the agency will also be higher. Here we assume that under a voluntary regime, only the larger oil companies (who sell 65 % of all lubricating oil sold in New Zealand) would contribute<sup>24</sup>. Under such a scenario, the levy would be estimated as follows:

$$\text{Levy} = \frac{\text{Total Annual Cost}}{(\text{Total Lubricating Oil Sold}) \times 65\%}$$

The above follows from the fact that if only the larger oil companies contribute, then the levy will be applied to only 65% of all the lubricating oil that is sold.

Figure 14 illustrates levies (per litre of lubricating oil sold) for a centralised collection agency funded by either a voluntary or compulsory levy at point of sale (and assuming that oil consumption increases).



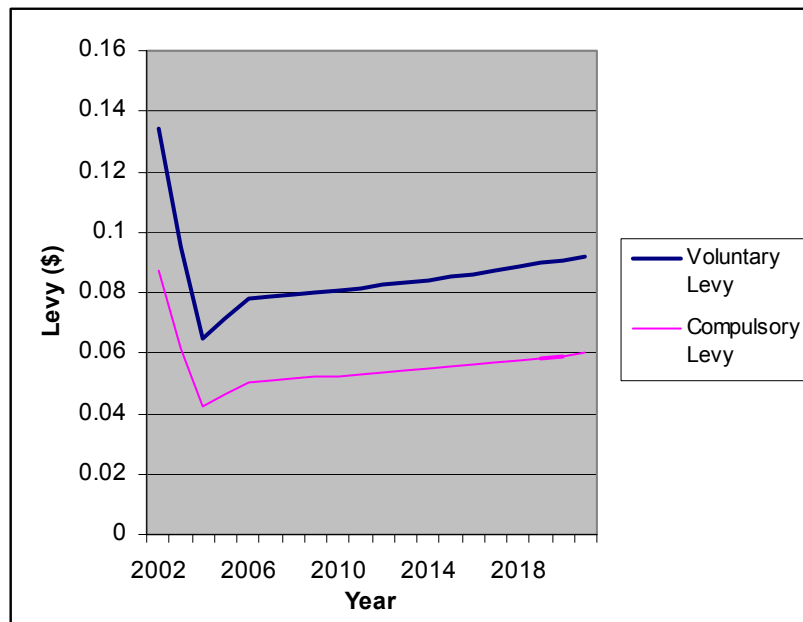
**FIGURE 14 : LEVIES UNDER A CENTRALISED COLLECTION SCHEME ASSUMING AN INCREASE IN OIL CONSUMPTION.**

Under the compulsory levy scheme, levies start out at around 9 cents per litre and drop to 4 cents per litre in 2004 (when the agency has lower transportation and collection costs). The levies gradually increase to 4.5 cents per litre and remain relatively constant from 2013 onwards. Note that the trends in magnitude of the levy will mirror that of the costs associated with running the collection agency.

<sup>24</sup> Note that anecdotal evidence suggests that this is unlikely. Oil companies such as Shell, BP, Mobil and Caltex have stated that they will not contribute unless *all* participants share the cost. This assumption has been made to give us some idea of what a levy under a voluntary scheme would look like.

The levies under the voluntary scheme are higher than those under the compulsory scheme. The initial levy is just over 13 cents per litre, decreasing to 6 cents per litre in the first three years. As with the compulsory scheme, the levy gradually increases (as costs incurred by the agency rise due to larger amounts of oil being collected) and eventually levels out at approximately 7.5 cents per litre.

The levy will also depend on how much oil is sold. The lower the amount of oil sold, the higher levy, as costs are being spread over a lower volume.



**FIGURE 15: LEVIES UNDER A CENTRALISED COLLECTION SCHEME ASSUMING A DECREASE IN OIL CONSUMPTION.**

Figure 15 illustrates the magnitude of levies under a centralised collection scheme if oil consumption declines. Note that unlike the scenario where oil consumption increases, the magnitude of the levy increases, as opposed to levelling out.

Table 8 illustrates the results of the cost benefit analysis for a centralised collection scheme assuming an increase in oil consumption.

Table 9 illustrates the results of the cost benefit analysis assuming a decrease in oil consumption.

| Discount Rate               | 5%              | 10%             | 20%             |
|-----------------------------|-----------------|-----------------|-----------------|
| Present Value of Total Cost | \$44,247,650.55 | \$30,662,575.14 | \$18,180,220.96 |

|  |                |                |                |
|--|----------------|----------------|----------------|
| Total Oil Recovered (litres)   | 584,438,290.38 | 584,438,290.38 | 584,438,290.38 |
| Ratio of Total Oil Recovered to Present Value of Total Cost (litres per dollar of present value of total cost) | 13.21          | 19.06          | 32.15          |

**TABLE 8 : PRESENT VALUE OF TOTAL COST UNDER A CENTRALISED COLLECTION SCHEME ASSUMING AN INCREASE IN OIL CONSUMPTION.**

| Discount Rate   | 5%           | 10%          | 20%          |
|---|--------------|--------------|--------------|
| Present Value of Total Cost   | \$31,720,400 | \$23,480,688 | \$15,261,228 |
| Total Oil Recovered (litres)  | 348,037,871  | 348,037,871  | 348,037,871  |
| Ratio of Total Oil Recovered to Present Value of Total Cost<br>(litres per dollar of present value of total cost) | 10.97        | 14.82        | 22.81        |

**TABLE 9: PRESENT VALUE OF TOTAL COST UNDER A CENTRALISED COLLECTION SCHEME ASSUMING A DECREASE IN OIL CONSUMPTION.**

As was the case with the status quo and stewardship regime, both present value of total cost and the ratio of oil recovered to present value of total cost decreases under the scenario where oil consumption decreases over time.

#### D.4.4 Summary

Of the three regimes analysed, the centralised collection regime has the highest projected volume of oil recovered. This scheme also provides the best “value for money” with respect to the ratio of total oil recovered to present value of total cost. Figure 16 and Figure 17 illustrate the present values of total cost as well as the ratio of total volume recovered to present value of total cost for the three regimes. We can see from Figure 16 that the regime with the highest present value of total costs is the stewardship regime. This can be attributed to three facts. The first is the rather high set-up cost associated with a “take-back” regime. Even though retailers would be allowed to use plastic igloos as a take-back facility, there are a very large number of retailers of motor oil across the country, making the total cost of set-up very high. Second, the administration costs of a stewardship regime, while low for the individual retailer, are high when we consider the accumulated effect. Third, even though the recovery rate improves under the stewardship regime, there is no centralised coordination of the collection effort. Retailers negotiate individually with a transporter or collector to have their oil picked up. (Hence, the assumption that the cost of transportation in the long term is the same as that in the short term - 17 cents per litre). Under the stewardship regime there is no abatement in total cost in the long term due to reduced transportation and collection costs.

Note that the present value of total cost for the centralised collection regime is very similar to that of scenario 1 of the status quo. This is particularly interesting when we compare the total volume of oil recovered under the two regimes. Under the centralised collection regime almost 600 million litres of used oil was recovered over the 20 year period, whilst under scenario 1 of the status quo only 410 million litres was recovered (only 260 million litres was recovered under scenario 2 of the status quo).

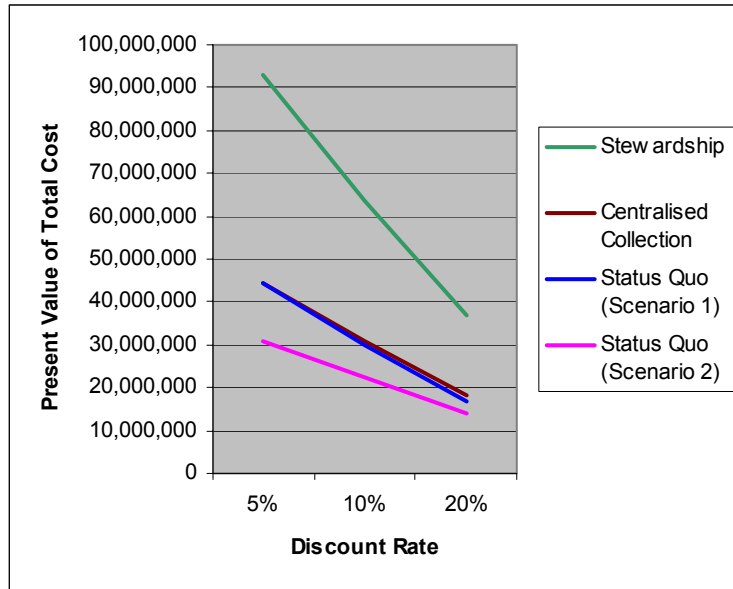


FIGURE 16 : PRESENT VALUES OF TOTAL COST ASSUMING AN INCREASE IN OIL CONSUMPTION.

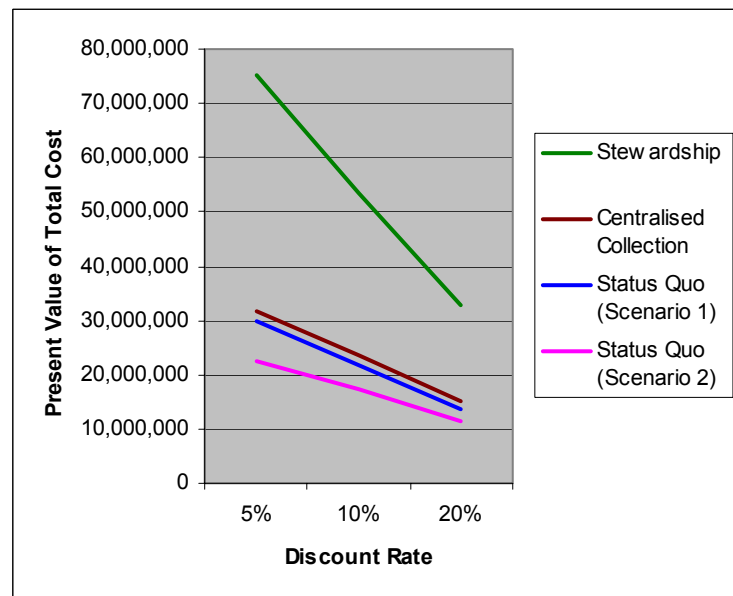
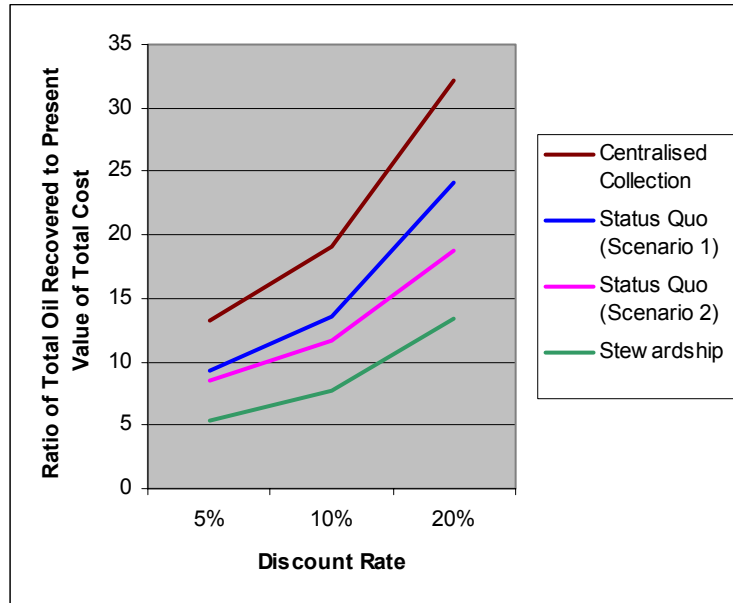
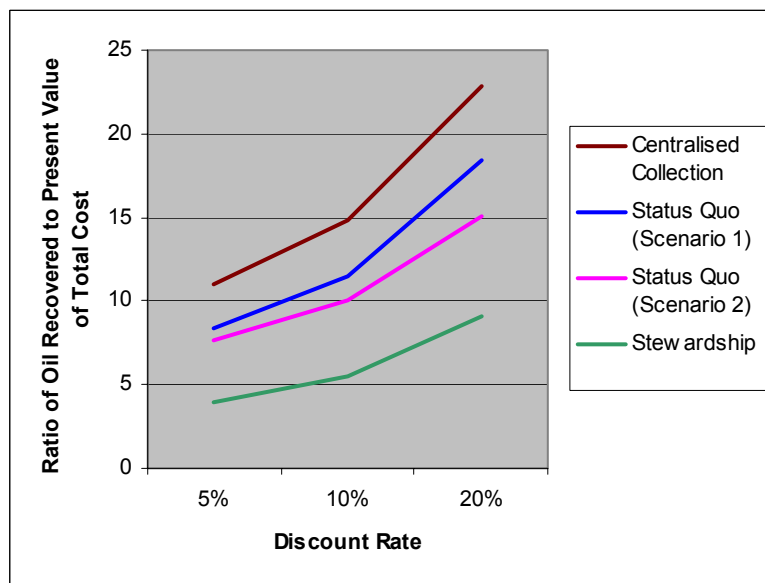


FIGURE 17 : PRESENT VALUES OF TOTAL COST ASSUMING A DECREASE IN OIL CONSUMPTION.

While the actual magnitude of present value of total cost varies depending on whether oil consumption increases or decreases, the trend remains relatively constant, with the stewardship regime exhibiting the highest cost, and scenario 2 of the status quo exhibiting the lowest. Note that the present value of total cost for the centralised collection scheme and scenario 1 of the status quo are once again similar in magnitude.



**FIGURE 18: RATIO OF TOTAL OIL RECOVERED TO PRESENT VALUE OF TOTAL COST ASSUMING AN INCREASE IN OIL CONSUMPTION.**



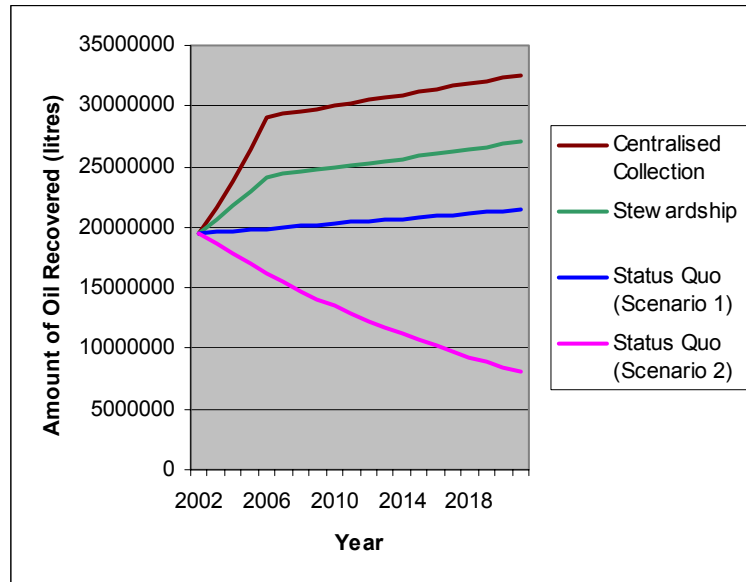
**FIGURE 19: RATIO OF TOTAL OIL RECOVERED TO PRESENT VALUE OF TOTAL COST ASSUMING A DECREASE IN OIL CONSUMPTION.**

Figure 18 and Figure 19 give us some indication of how many litres of oil are recovered for every dollar of present value of total cost. The higher the ratio of total oil recovered to present value of total cost, the more “value for money” derived from the scheme. From Figure 18 we can see that the centralised collection scheme yields the highest ratio, with the stewardship regime yielding the lowest. While both scenarios of the status quo also yield higher ratios than the stewardship scheme, it is important to note that while the costs associated with the take-back regime are very high, the associated environmental implications are far more acceptable than under the status quo.

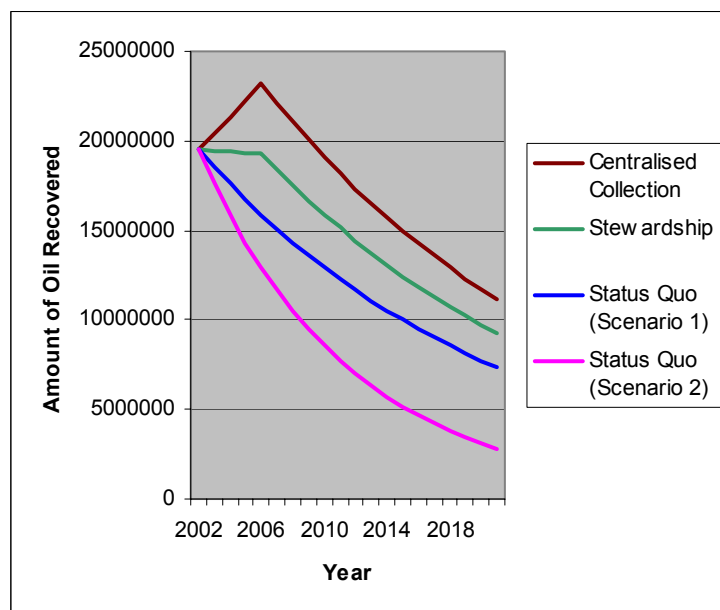
Under the scenario where oil consumption decreases we note that while the magnitude of these ratios vary, the trends are unchanged. In other words, the centralised collection

scheme still yields the highest value for money, while the stewardship scheme yields the lowest.

Figure 20 and Figure 21 illustrate the amounts of used oil collected by the various regimes.



**FIGURE 20: AMOUNT OF RECOVERED USED OIL ASSUMING AN INCREASE IN OIL CONSUMPTION**



**FIGURE 21: AMOUNT OF OIL RECOVERED ASSUMING A DECREASE IN OIL CONSUMPTION.**

The best performance (in terms of oil collected) is displayed by the centralised collection and stewardship regimes (under both scenarios of oil consumption trends).

Under the scenario where oil consumption decreases, the total amount of oil recovered decreases with time for all regimes. In the case of the stewardship and centralised collection regimes it is important to note however, that this decline is attributable to decreased consumption, as opposed to a low recovery rate.