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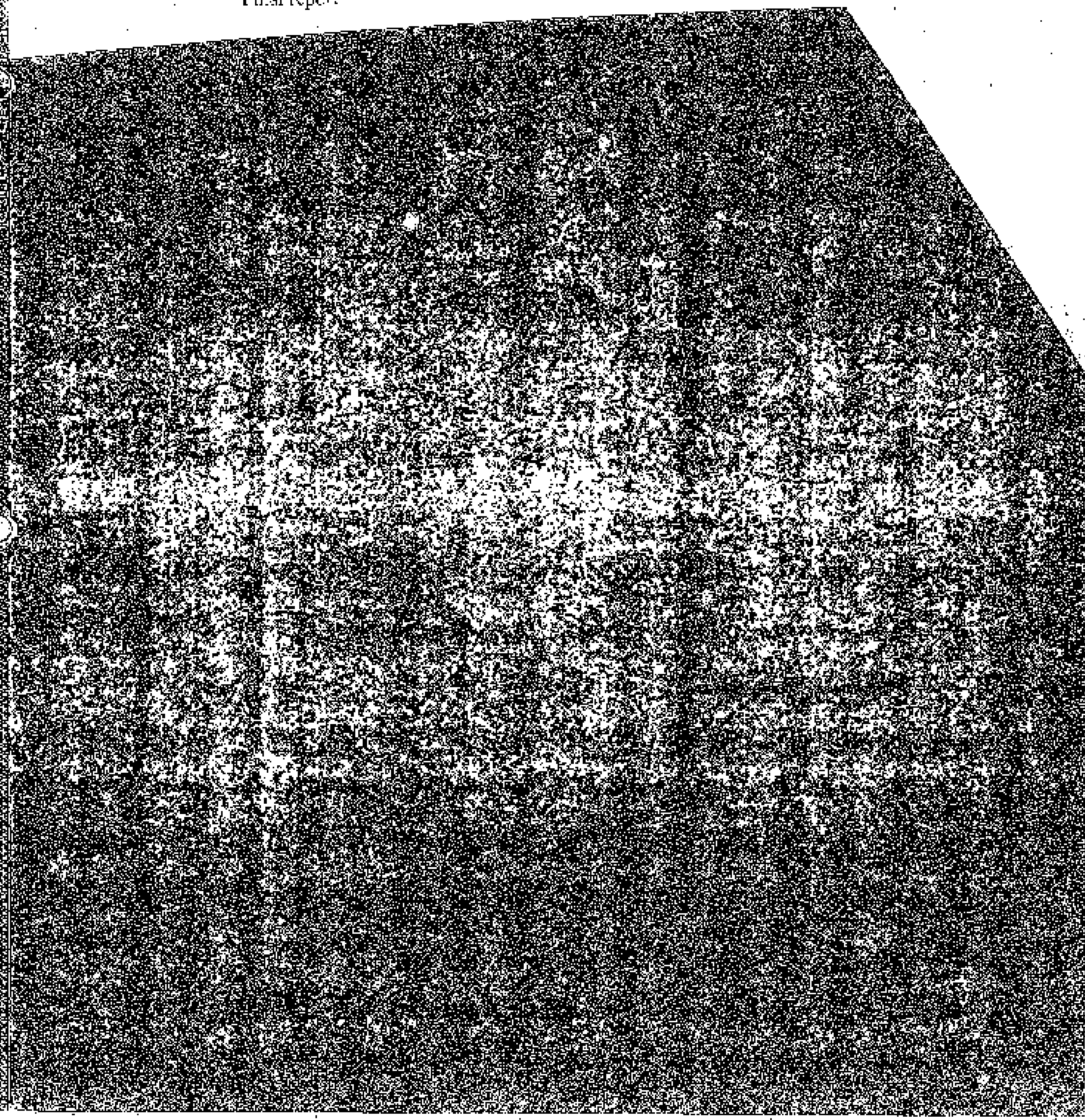
Research and Consulting

Economic Value of Strategic Options for [illegible]

Final report



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ECORYS

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Research and Consulting

Economic Value of Strategic Options for Refineria di Kòrsou

Final report

Client: Refineria di Kòrsou

ECORYS-NEI
Macro & Sector Policies

Leo Beumer
Ilse van de Velde
Nol Verster

Rotterdam, 26 October 2005

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Preface

On behalf of Refineria di Kòrsou N.V. (RdK), ECORYS-NEI presents in this report the results of its research regarding the respective economic value of the refinery's distinct strategic options. ECORYS-NEI is grateful for the pleasant and productive cooperation with the management of RdK throughout the implementation of the project. This in particular concerns the provision of valuable background information through RdK, ranging from details on the refinery's emission levels and financial position to data on costs arising in the case of dismantling the refinery and cleaning up activities. We are also very much obliged for RdK's assistance in specifying the distinct strategic alternatives available to the refinery and highly appreciate RdK's help in identifying and establishing contact with institutions and individuals, who further informed the outcomes of this study. As well, we are thankful for the provision of office space and equipment on RdK's premises.

Moreover, ECORYS-NEI is indebted to the Department of Economic Affairs (DEZ) of the Curaçao Island Territory for their contribution to the building of economic short and medium term scenarios, which were a crucial input to the estimation of direct and indirect effects related to the construction, operation and future dismantling of the refinery. We also want to express our gratitude for DEZ's support in adapting the "Curalyse" model to the purpose of this study and for its contributions to the interpretation of results.

Last but certainly not least, we wish to cordially thank all our interview partners and the institutions they represent for the highly useful and practical information that greatly added value to this report.

The ECORYS-NEI team
Rotterdam, 20th of October 2005

Executive Summary

Background

Refineria di Kòrsou N.V. (RdK) is the owner of the ISLA-refinery in Willemstad, Curaçao. Currently Petroleos de Venezuela S.A. (PDVSA) is leasing the refinery. The lease contract will expire in 2019.
However, RdK would like to preserve the refinery for Curaçao also after 2019, if and as long as it will be capable to earn net welfare benefits to the island.

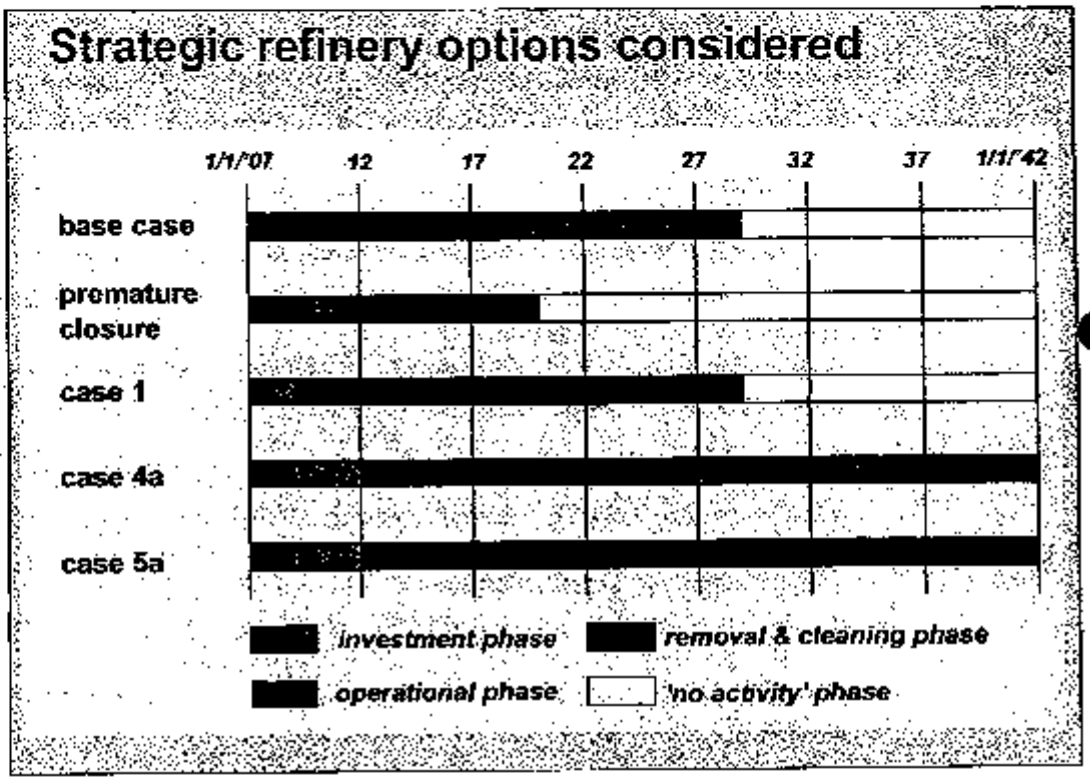
This condition will be fulfilled if on the one hand future investments in ISLA-activities by island parties generate more jobs and income than investing the same amount in other activities, and if on the other hand such a positive income difference counterbalances the negative environmental effects of ISLA.
One specific aspect, related to the potential contribution of ISLA to the welfare of Curaçao concerns the level of the lease fee, RdK presently receives. Some parties have the impression that this level is too low and want it to be raised substantially, before or at least after 2019.

In order to assess the earning capacity for Curaçao of future ISLA-activities as well as the potential of a lease fee increase, RdK asked Purvin & Gertz (P&G) to carry out a strategic study and market outlook analysis. P&G recently presented their conclusions on the technical feasibility, commercial viability and financial feasibility of a number of strategic options for the refinery.
From the set of established viable options RdK selected the following alternatives for a further welfare-economic assessment (Diagram 0.1):

- ***P&G Case 1 or the 'minimum investment case':*** according to which the present ISLA complex will be continued till closure in 2019, and new investments will be restricted to three flue gas scrubbers to be installed to clean the emissions from the current 419 t/d of refinery residual fuel consumption;
- ***P&G Case 4a, or the 'delayed coker case':*** in this case investments are made to heat the refinery furnaces with low sulphur residual fuel oil (instead of the present consumption of residual fuel with high sulphur content); the investments are assumed to take place in 2010 and 2011, whereas the refinery operations will be continued until 2032;
- ***P&G Case 5a, or the 'gasification case':*** this option implies investments (in 2010 and 2011) in a gasification unit providing clean syngas to refinery furnaces, and partially replacing the steam and power production from the utility plant; refinery operations will last till 2032.

The main findings of the P&G study are used as a basis of the economic assessment, prepared by ECORYS.

Diagram 0.1 Time schedule for implementing the base case and strategic refinery options



Questions addressed in this report

Given the background, RdK requested ECORYS B.V. to carry out an analysis in order to answer the following questions:

I. Are the strategic options for a refinery on Curaçao, identified by P&G:
   a. desirable for the island from a macro-economic point of view;
   b. financially feasible for RdK, given:
      - the existing lease contract with PDVSA, which compels RdK to take a share in the obligatory environmental investments;
      - the responsibility of RdK regarding the removal of all plant installations, and to clean the site in an environmentally satisfactory way (implying the need of substantial fund formation)?

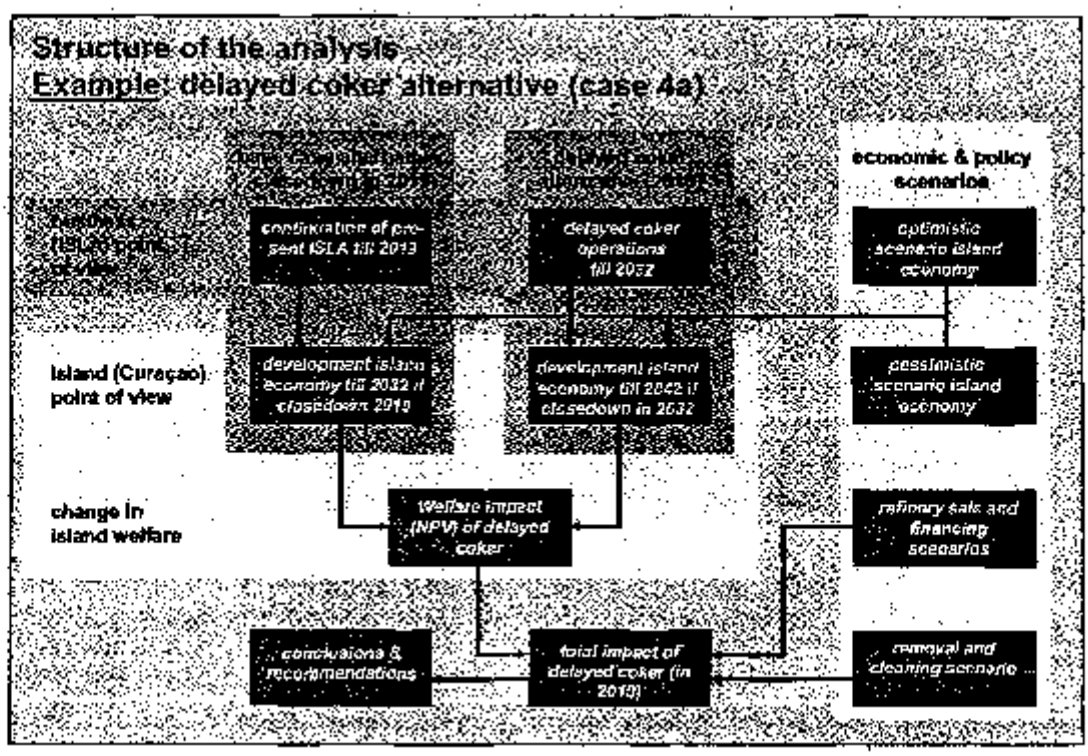
II. What economic and social impact do they have on Curaçao, in terms of:
   - national value added (VA) and local employment effects;
   - emissions and health conditions;
   - spending of funds reserved for plant removal and site cleaning during 10 years after finishing the refinery activities?

III. What will be the impact on RdK's financial position:
   - of changing RdK's investment share in the refinery plant;
   - of selling the refinery?

Assessment methodology

Questions Ia and II were answered by carrying out an economic cost-benefit analysis (CBA) for Curaçao as a whole. To answer the questions Ib and III a rough cash-flow analysis was made for RdK, in order to assess the financial capacity of the refinery owner to contribute to investment and dismantling outlays foreseen for each year during the period relevant for each strategic option.
The structure of the analysis is summarized in Diagram 0.2 and explained below (using Case 4a as an example).

Diagram 0.2 Structure of the assessment procedure



The economic CBA consists of the following main steps.
For a proper economic assessment of the impact of the strategic options, available to RdK with respect to ISLA, one has to look first at the annual advantages and disadvantages for every island party of each option (here the delayed coker case). These (dis)advantages are defined as differences between the annual development during the life span of the refinery in each option and the annual development in the base case (i.e. a continuation of the current situation until 2019, immediately followed by closure and a ten year period of dismantling of installations and site cleaning).
The next step consists of attaching a monetary value to all advantages and disadvantages. For many items the monetary value is not very difficult to determine (e.g. work opportunities for ISLA employees and for contract workers hired by ISLA). Other effects of the strategic options, however, are more difficult to quantify or/and express in money terms (e.g. hindrance of residential groups by pollutants, noise or stench, or the value increase of the refinery site after closure and site cleaning).

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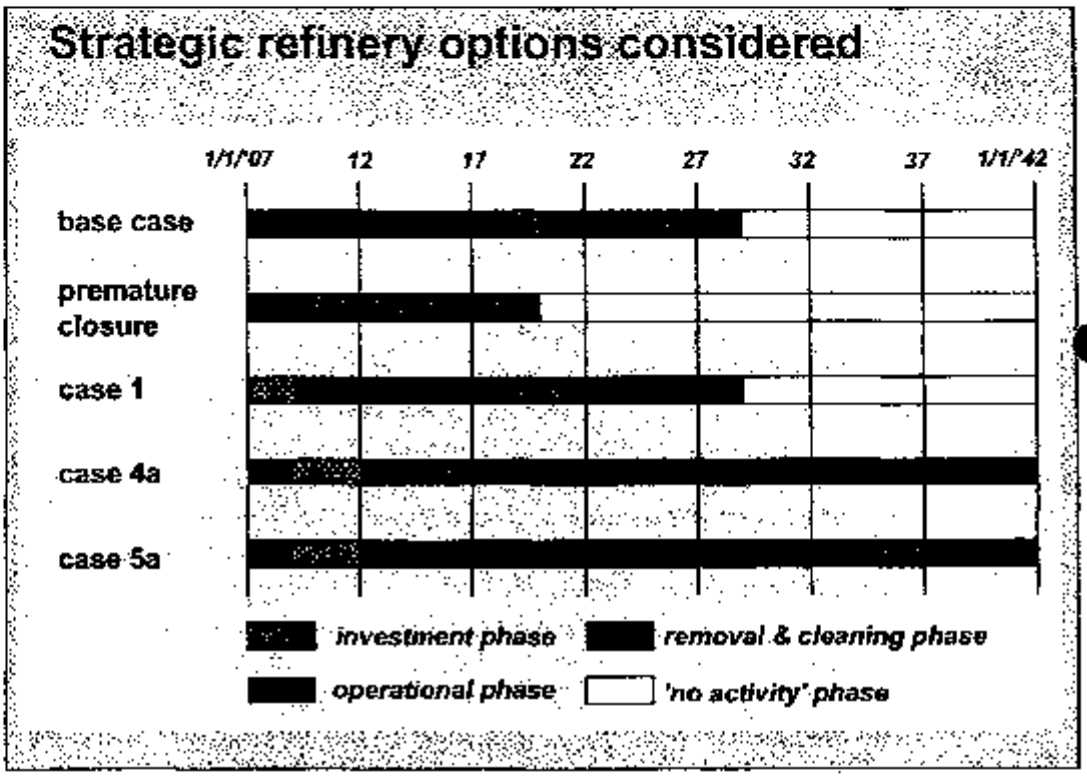

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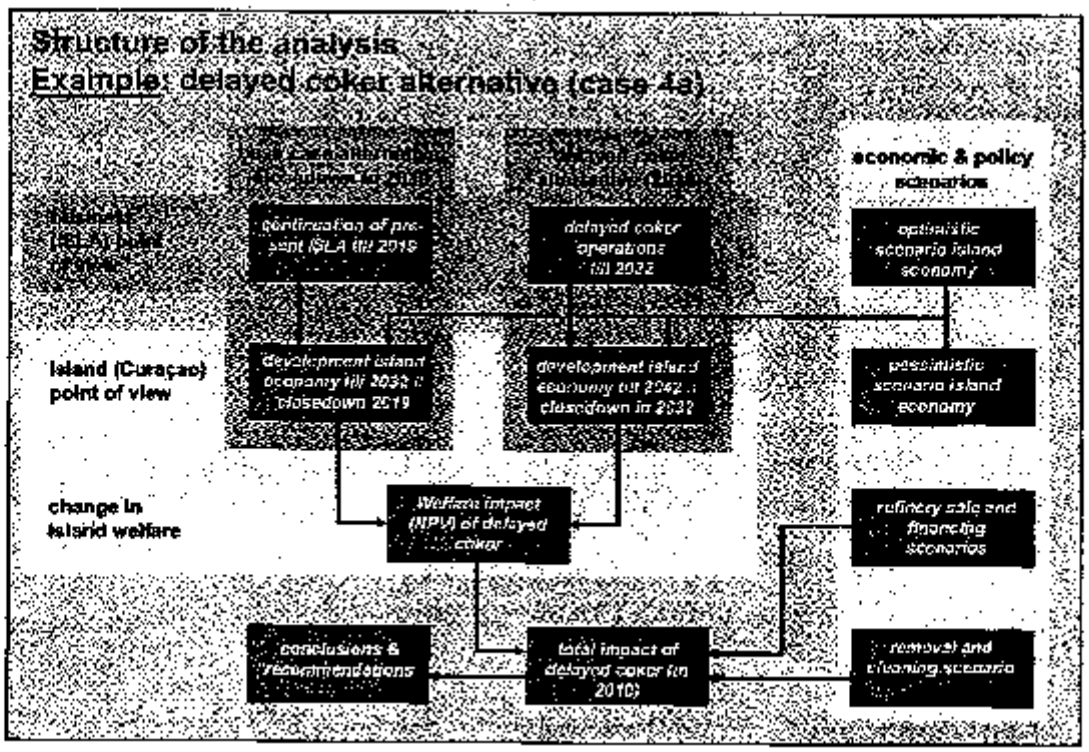

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The next step consists of attaching a monetary value to all advantages and disadvantages. For many items the monetary value is not very difficult to determine (e.g. work opportunities for ISLA employees and for contract workers hired by ISLA). Other effects of the strategic options, however, are more difficult to quantify en/and express in money terms (e.g. hindrance of residential groups by pollutants, noise or stench, or the value increase of the refinery site after closure and site cleaning).

The third step is to aggregate the monetary values of each of these items over all individuals and groups who experience them and to calculate the annual net benefit for the island as a whole.
The final step consists of weighing the aggregate annual benefits with a discount rate, and to sum all yearly weighted net benefits (the further ahead in the future a benefit, the lower its relative weight in the present value). The net present value (NPV) is used as the overall assessment criterion
This approach assessment is called economic cost-benefit analysis (CBA). The details of the approach are described in Chapter 2.

To carry out the CBA-calculations a number of practical assumptions must be specified with respect to the future performance of the island economy, the question if RdK remains the owner of the refinery or if it will sell ISLA, the degree in which RdK – in case it retains the ownership - will participate in future investments and the equity share required, the discount rate to be used to calculate the net present value (NPV) of the annual costs and benefits, and finally with respect to alternative ways to estimate the damage costs of air pollution, caused by their refinery.

The following alternative assumptions have been specified and used in the 'basic variant' and a number of alternative calculation variants (sensitivity analysis; see section 5.3). If not explicitly specified, the results presented hereafter refer to the assumptions regarding the basic variant.

	Basic variant	Other variants
Re-employability of unemployed workers	Optimistic	Pessimistic
Sale of ISLA	No	Yes
RdK share in investment (case 4a and 5a)	10%	20%, 30%
Minimum prescribed RdK equity share	100%	40%
Pollution reduction impact (illness effects)	High estimation	Central, Low est.
Reduced health costs	High	Low
Removal and site cleaning	Both	Only removal
Social discount rate	10%	8%, 12%

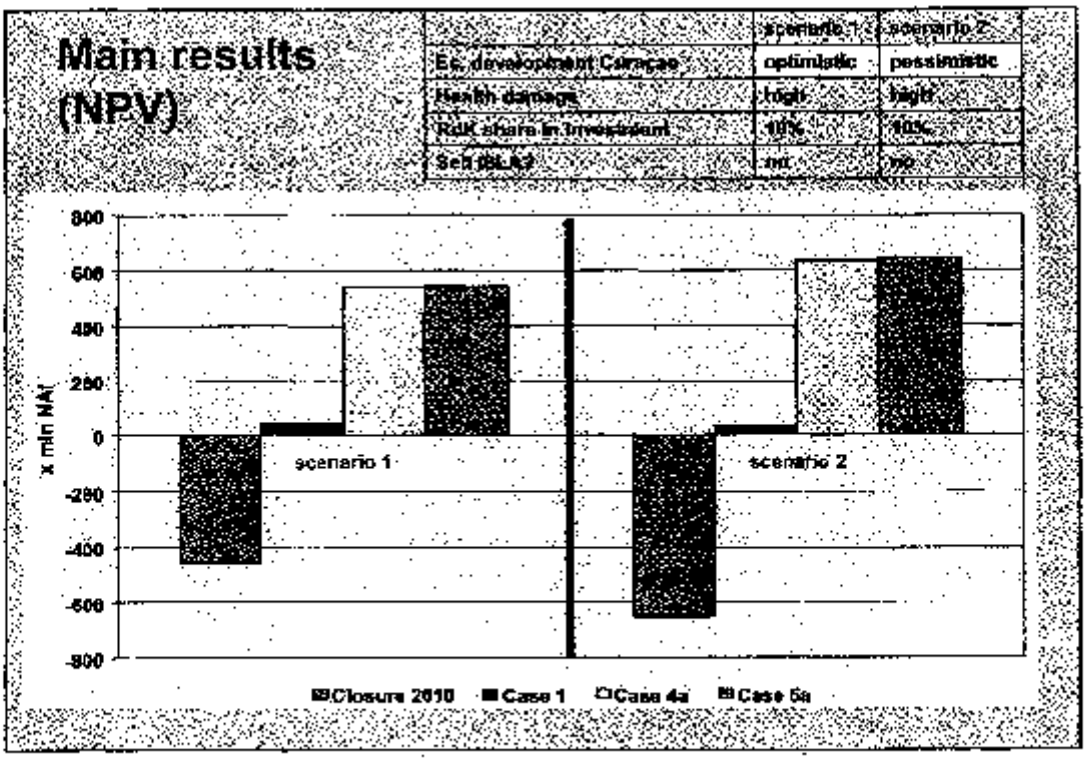
Total net benefit for the island of Curaçao

The net present values (NPV's) in 2005 of the expected annual economic costs and benefits during the period 2007-2042 of the four cases (each compared to the base case development) are presented in Diagram 0.3. The left hand side presents the expectations in case of an 'optimistic' view on the capacity of the local economy to quickly absorb local workers, becoming unemployed after the refinery closes down (2019 in Case 1; 2032 in cases 4a and 5a, and 2010 in the premature closure case). The results corresponding with the pessimistic scenario are shown at the right side of the diagram.

The diagram shows that the minimum investment case (case 1) has no net advantage for the island, compared with the base case (continuation of the present situation). Premature closure is very unfavourable in comparison with the base case. Both, the delayed coker (case 4a) case and the gasification (case 5a) case, however are advantageous. The net

costs (of the closure case) but also the net benefits (of the cases 4a and 5a) will be higher in the pessimistic scenario. In the closure case Curaçao will be confronted with a higher unemployment figure on the short term (i.e. from 2010 on, compared with the base case, where unemployment of ISLA workers and related local personnel will be postponed till 2019); in both modernization cases unemployment will appear much later (2032) than in the base case. The start of the unemployment period has an important influence on the net present value of the annual wage sum.

Diagram 0.3 Total net benefits for Curaçao of strategic options and premature closure



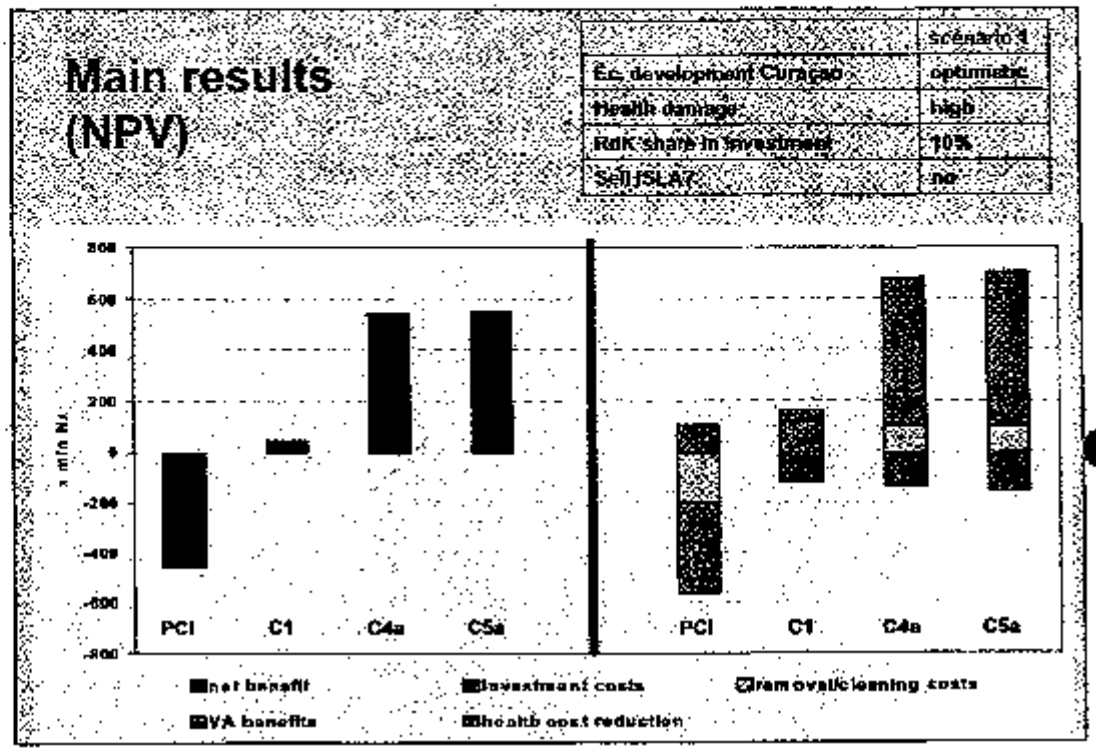
N.B. For case 1 an RdK share in investment of 25% (instead of 10%) is assumed.

Diagram 0.4 refers to the optimistic re-employment scenario. Here the NPV of the net benefit per case is presented on the left side, while the right side shows a rough breakdown of the net benefit into four main categories:

- (Net) investment costs, needed to realize cases 1, 4a and 5a, respectively (in fact: the difference between investment costs in each strategic case and in the base case);
- (Net) costs of removing the installations after closing the refinery, and of site cleaning;
- (Net) value added, directly or indirectly realized by island parties resulting from investment and operation activities, removal and cleaning expenditures[1];
- (Net) value of health cost savings, arising from the emission reduction of harmful substances.

[1] The total net value added benefit of Curacao from ISLA is reflected by a large influx of foreign currency. In this respect ISLA differs from most other foreign companies on the island. Other companies also hire local workers and contractors, but their payments are to a large extend compensated by return payments arising from local sales on the island, resulting in modest

Diagram 0.4 Breakdown of total net benefits per case



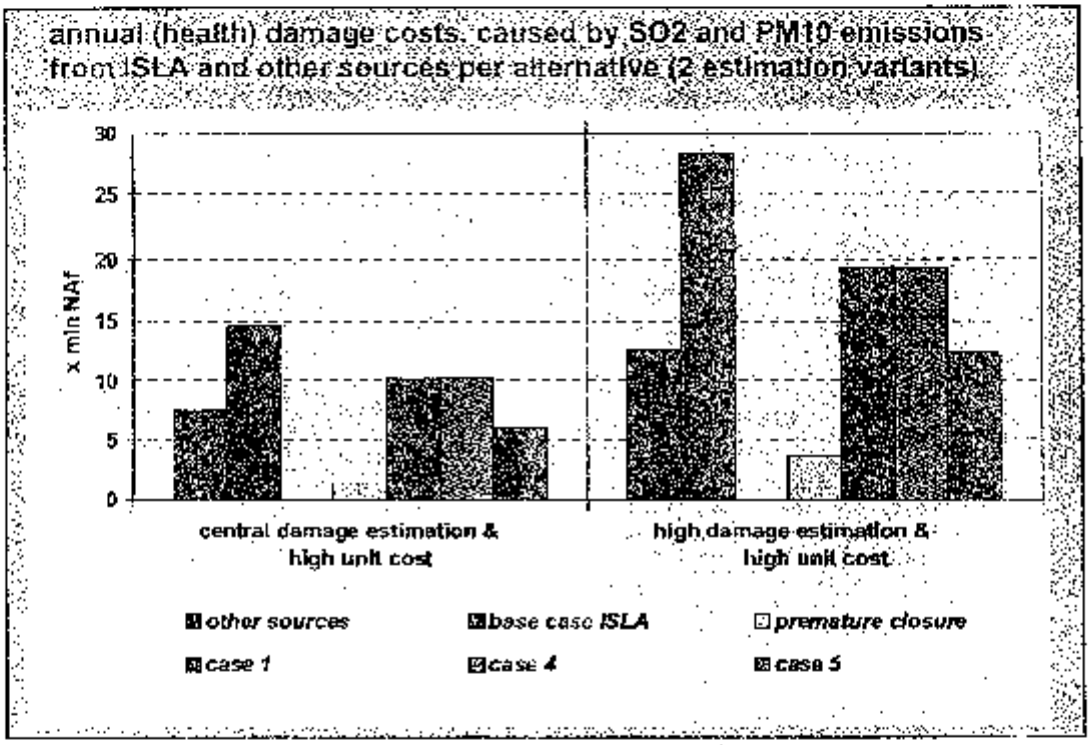
All three strategic cases offer more value added than the base case. The difference in this type of benefit is highest for cases 4a and 5a, because in both these cases operations will continue till 2032. Premature closure (PCI) in 2010, however, leads to a substantial welfare loss in comparison with the base case (closure in 2019).
Cleaning and removal costs are also relatively high in the PCI-case for the same reason. This type of costs is not relevant for case 1, because the assumed closure takes place in the same year as in the base case.
Investment costs differences are absent in the premature closure case. The highest investment costs are found in cases 4a and 5a.
Regarding the environmental impact, measured as health cost change, the largest difference with the base case occurs in the early closure case. The reason is of course that the complete stop of harmful refinery emissions will be brought forward in time.
Noticeable is the lack of net health damage reduction in case 4a (delayed coker case). Although the ground level concentrations of SO2 and PM10 in this case are lower than in the base case (see Table B.2 in Annex B), the period during which the pollution continues will be much longer for this modernization case (the refinery closes in 2032 instead of 2019).

Diagram 0.5 offers a look at the total annual environmental costs, which have been approximated by assessing health costs for a limited number of illnesses, caused by only two of the harmful substances emitted by ISLA (SO2 and PM10). The diagram presents the results for the central and high damage estimates, combined with the high health unit

net currency flows. ISLA on the other hand outsources permanently substantial assignments to local contractors, but exports most of its products to other countries. This leads to a relatively large inflow of foreign currency.

cost variant (see also section 2.3.4 and Annex B). For only two types of pollutants and only the health damage caused by these substances were quantitative data available. To compensate for the resulting underestimation of the environmental impact, it was decided to use the high health damage estimate and high health unit cost as input for the CBA in the basic variant. According to the variants presented the annual damage will decrease in all project cases (compared to the base case). Case 1 and case 4a show the same level of damage, while case 5a displays a lower health cost amount.

Diagram 0.5 Annual health cost: savings per alternative option



Financial position of RdK

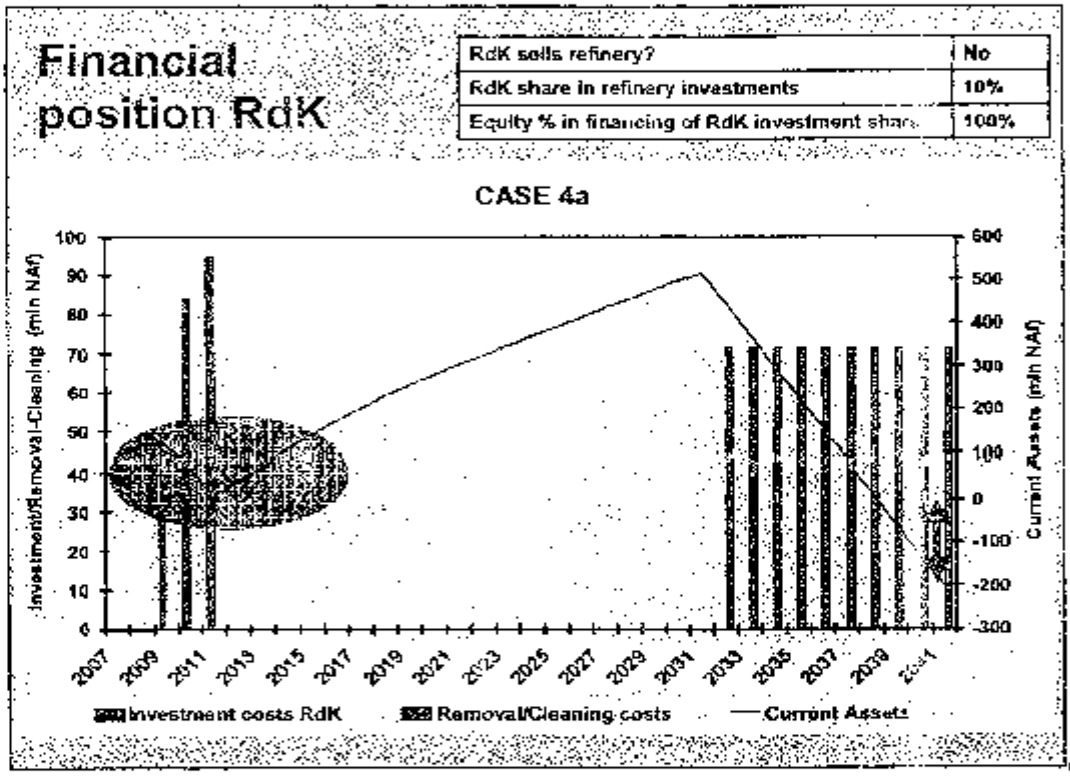
The basic variant of the cost-benefit calculations rested on the assumption that RdK remains the owner of the refinery and participates for only 10% in new investments. This variant is further characterized by the assumption that the equity capital of RdK will not be shared by other parties (obligatory 100% equity share).

Given the investment programs, corresponding with the cases 4a and 5a, the question rises how the obligation to participate in new investments influences the asset position of RdK on the short and on the long run. Will RdK be capable to participate in the investment program for the years 2009 to 2011, and if so, will RdK - given the existing lease fee amount - be able to restore its asset position, so that it can finance a satisfactory 10 year removal and site cleaning operation at the end of the operation period?

The answer to this question for the basic variant, applied to case 4a (delayed coker case), is presented in Diagram 06.

The continuous red line (cumulative asset balance) in the diagram shows that RdK in 2007 will start with a moderate current asset position (some NAF 100 million; see right axis), but that the investment obligation between 2009 and 2011 (brown columns; left axis) nearly depletes the asset supply (the dotted red line indicates a zero asset level). After 2011 the flow of lease fees restores the asset position, until from 2033 on yearly removal and site cleaning expenditures (blue columns) will again diminish the existing stock. It becomes clear from the diagram, that this time RdK will be confronted with a lack of funds to finance the expenditures of the last three years.

Diagram 0.6 Current asset position of RdK and expected expenditures 2007-2042



From the diagram it becomes clear that RdK may be confronted with serious short run as well as long run asset position problems, depending on the magnitude of the investments, the investment share RdK is forced to, the size of the lease fee, and the year the removal and site cleaning activities will start.

Calculations show further that for the base case, case 1 and especially premature closure the asset position of RdK will be far from sufficient to fulfill its obligations. In cases 4a and 5a RdK will be confronted with asset problems on the long run.

Table 0.2 Asset position of RdK (NAF million) in the long run for some financing variants (Case 4a)

Cumulative asset balance	Equity share RdK	RdK share in investment		
		10%	20%	30%
Prior to removal/cleaning:	40%	350	- 35	-410
year 2032	100%	515	305	95
Including removal/cleaning:	40%	-370	-750	-1,130
Year 2042	100%	-200	-410	-620

Table 0.2 shows how the financial position of RdK changes with variations in the investment share and in the equity share. Under all circumstances considered the asset position is not sufficient to finance the minimum necessary expenditures for removal and site cleaning. If RdK would switch to pay dividends to its (government) owner in the short run, it would be forced to borrow funds to fulfill its investment obligations. In the long run this will have as a consequence that the lack of funds for removal and site cleaning after operations will increase substantially.

Conclusions

The results of the analysis presented before lead to a number of important conclusions.

Total net benefit (net present value difference with base case):

- Early closure of the refinery (around 2010) is definitely not an economic option: although the net present value of health cost savings for this alternative are higher than for all three other cases considered, this benefit will not counterbalance the loss of value added;
- Case 1, the 'minimum investment case' with an accent on environmental investments and refinery closure in 2019 appears also not to be a favorable economic option. The net benefit (compared to the base case) is negligible. Moreover, RdK is facing significant financial problems in the short run, in case 50 percent of the environmental investments are financed with 100 percent equity. Only if 40 percent is based on equity and 60% on debt financing, RdK's financing problems in the short run are solved, but will increase significantly in the long run;
- Both, case 4a and 5a investments on the other hand, will result in a comparable amount of net economic benefits for Curacao. As the analysis carried out here is based on a provisional market outlook by P&G, and because the CBA itself was also in some respects characterized by rather rough approximations, more detailed and accurate analyses are desired, before concrete decisions should be taken.

Environmental (health) effect:

- Annual environmental damage, in terms of health cost saved, is - according to the high damage, high unit cost estimation - in case 4a more than NAF 9 million and in case 5a nearly NAF 16 million lower than the base case (base case health damage level: some NAF 28 million a year).

Financial position RdK:

- The financial position of RdK does not offer much room for a (10% or higher) contribution to large investments in ISLA (such as in case 4a and 5a). All the more not, if RdK has the obligation to remove the ISLA installations after closure and to clean the refinery site;
- Removal & cleaning costs after closure will represent a huge burden for RdK/Curaçao. In case of closure in 2010 or 2019 the existing assets are insufficient. Reservation of funds is inevitably required if removal and cleaning should be carried out from 2032 onward;
- A win-win situation might be possibly achieved by selling the refinery and by using the money gained for new investments in profitable alternative activities in Curaçao

in order to put aside part of its returns for the realization of the removal & cleaning activities needed;

- All financial flows related to inputs and outputs of the refinery (now and in the future) will only fully benefit PDVSA, the lessee of the refinery. Consequently all future investments of RdK related to the refinery are in principle non-profitable;
- Substantial investment efforts required from PDVSA (case 4a and 5a), assuming RdK's share will not be more than 10 percent of total investments, will have significant impact on the financial position of the operator (see Annex D), and therefore will result in less room for increasing the lease fee for RdK (in particular in case 5a).

1 Introduction

1.1 Background

Refinería di Kòrsou N.V. (RdK) is the owner of the ISLA-refinery in Willemstad, Curaçao. Currently Petroleos de Venezuela S.A. (PDVSA) is leasing the refinery. The lease contract will expire at the end of 2019.

RdK and ISLA recently implemented the 'ISLA-refinery Upgrading Program' (IRUP). This program consisted of investments in process techniques and in related environmental facilities. Moreover, a new utility plant was constructed at the premises of the refinery, carried out through a Build, Own and Operate scheme (and therefore called the BOO project).

RdK believes that these recent investments are not sufficient to preserve refinery activities for Curaçao after the expiration of the present lease contract in 2019, if the product range and the production processes will not become better tuned to expected market developments and geared to environmental standards. RdK is convinced that the commercial success of a refinery depends on a number of crucial conditions, such as:

- Gearing production processes better on existing and expected market demand;
- Complying with existing environmental standards;
- Cost effective production (compared to competitors);
- A high degree of capacity utilization.

For that reason RdK reflects on the strategy it should follow from now on (until and after 2019).

1.2 The problem

Starting point was the following problem situation RdK feels confronted with:

- Continuation of the present ISLA configuration will not be commercially and financially viable after 2019. If the installations will not be brought up to date in due time, Curaçao will loose the refinery;
- The island government (and RdK) is further confronted with a political problem. ISLA currently causes environmental problems: emissions exceed existing standards. Can the emission level be further reduced, without loosing refinery employment and sacrificing part of the present economic diversification which is very useful to the island economy? After closure of the refinery RdK will, moreover, be confronted with expensive installation removal and site cleaning expenditures. The more

imminent such a closure, the more need to anticipate on such activities and expenditures;
- According to some the present lease contract with PDVSA is not satisfactory. The amount received is too low to create sufficient funds for removal and cleaning activities. It further is not geared to the contract agreement of a 50/50 split of environmental investment costs among PDVSA and RdK. ISLA doesn't have to pay taxes; the (low) lease amount is therefore the only contribution PDVSA makes to the island of Curaçao in return for the availability of the site and the permission to pollute the environment. Furthermore, the lease contract is not related to realized profits (which may be very high, given the actual oil product prices).

The main question RdK wanted to be answered, given these problems, was:
Which possibilities are there, under the economic and environmental conditions to be expected, to continue refinery activities on the island of Curaçao within an acceptable social economic context?

In order to answer this question some further questions had to be answered:
- Can a refinery on Curaçao in the long run be commercially viable, and what type of refinery would that be, given the requirement that the installation must comply with the latest environmental standards? (Specify the optimal product range and configuration.)
- What will be the macro-economic and environmental impact on the island economy and the population, in case the present refinery closes, continues its operations, or will be substantially modernized?
- In case a continuation seems commercially viable: what are the possibilities for RdK to better participate in the profits of the operator, and to allocate sufficient funds to solve existing and anticipate on future environmental problems?

1.3 Strategic decision options

To answer the first question RdK asked Purvin & Gertz (P&G) to carry out a strategic study and market outlook analysis. P&G recently presented their conclusions on the technical feasibility, commercial viability and financial feasibility of a number of strategic options for the refinery.
From the set of established viable options RdK has selected the following alternatives for a further welfare-economic assessment (see also Diagram 0.1):
- ***P&G Case 1 or the 'minimum investment case':*** according to which the present ISLA complex will be continued till closure in 2019, and new investments will be restricted to three flue gas scrubbers to be installed to clean the emissions from the current 419 t/d of refinery residual fuel consumption;
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- ***P&G Case 5a, or the 'gasification case':*** this option implies investments (in 2010 an 2011) in a gasification unit providing clean syngas to refinery furnaces, and partially

replacing the steam and power production from the utility plant; refinery operations will last till 2032.

1.4 Questions addressed in this study

The P&G study is carried out at a pre-feasibility level. Its main findings are used here as a basis of the economic assessment study, prepared by ECORYS, and in which the other questions mentioned in section 1.2 were answered. These questions can be further specified as follows:

I. Are the strategic options for a refinery on Curaçao, identified by P&G:
   - desirable for the island from a macro-economic point of view;
   - financially feasible for RdK, given:
     - the existing lease contract with PDVSA, which compels RdK to take a share in the obligatory environmental investments;
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   - of changing RdK's investment share in the refinery plant;
   - of selling the refinery?

1.5 Structure of the report

In order to answer the previous questions an economic cost benefit analysis has been carried out based on the results of the market outlook by Purvin & Gertz. In this report the results of the economic CBA are presented, i.e. a description of the advantages and disadvantages of choosing each of the three strategic options instead of a continuation of the existing situation (the base case).

The report is structured as follows. First the elements of the CBA approach are described and explained in Chapter 2. Chapter 3 contains a further description of the strategic cases to be evaluated and the base case development they are compared with. Moreover it pays attention to the environmental impacts and the effects of dismantling the installations and cleaning the ISLA site after ending operations. Then attention will be paid to the macro-economic context within which the refinery cases might develop. The long run performance of the island economy will have an impact on the expected benefits (Chapter 4). The main results of the study will be derived in chapter 5, where the expected developments according to each of the three selected strategic options are compared with the base case development. If none of the strategic options would be realized and, moreover, if there are reasons to doubt even the feasibility of the base case (with expected

closure in 2019), a premature closure (in, say, 2010) should be faced. The economic consequences of this possibility are also presented in this chapter. For all four cases attention is paid to the total net benefits for Curaçao according to the basic variant. Next, a breakdown into four main categories of effects is presented. Special attention is paid to the external effects. Finally, results of the sensitivity analyses are briefly discussed. Of course, the strategic options studied do have not only impacts on the island economy as a whole, but also on RdK as the present owner of ISLA. Chapter 6 shows the effects of each option on the financial position of RdK, given the present lease fee construction. The possible consequences of changes in investment share and refinery ownership are also discussed in this chapter. Finally, the main conclusions from the analysis are presented in chapter 7.

The report furthermore contains a number of annexes to explain and amplify the procedures followed to deal with some important results. The last one contains detailed information on the main results of the CBA, which is discussed briefly in chapter 5.

2 Methodology and Research Steps

2.1 Introduction

In order to assess if the strategic options 1, 4a and 5a for a refinery on Curaçao, identified by P&G as technically and commercially feasible, are economically desirable for the island an economic cost-benefit analysis (CBA) was carried out.
A CBA is an analytical instrument used to answer the question if; over the life time of an investment project, benefits do justify the use of the scarce resources to the national society. Society is conceived as the sum of all national (or island) economic subjects. Applying this instrument to new refinery investments needed to realize the strategic options provides the answer on questions Ia and II (section 1.4).

The economic or aggregated national profitability may be positive, despite the fact that one or some of the national parties experiences a net loss. This is no point of concern to the CBA analyst, who is in the end only interested in the net aggregate result. However, one of the national parties is of course RdK, the present owner of ISLA who will become the initiator of the project if it appears to be viable. It is important to know what the financial consequences of implementing the cases may be for this crucial party. The second part of the approach is therefore a (rough) cash flow analysis, which concentrates on the question if RdK will have sufficient funds available during the lifetime of the project to cover its financial obligations. This part refers to questions Ib and II (section 1.4).

2.2 Economic Cost Benefit Analysis

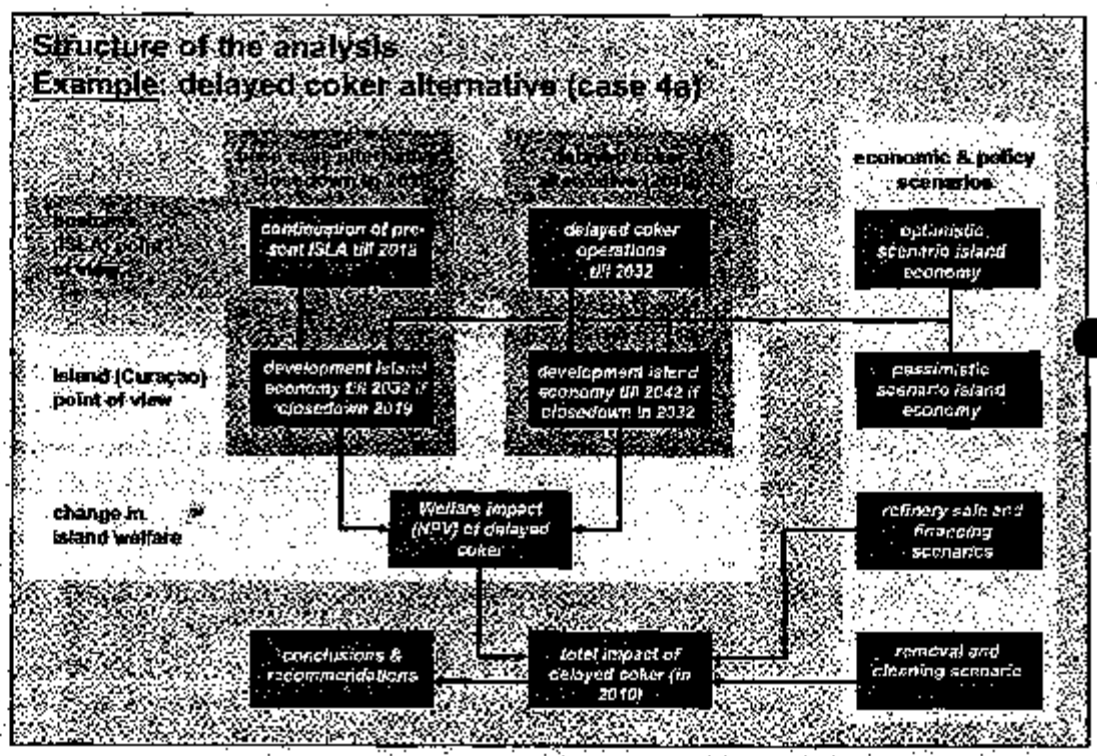
The CBA carried out here should be characterized as a 'pre-feasibility' study, needed to get a first firm idea about the economic profitability of the project. Given the rough commercial pre-feasibility assessment provided by P&G, it makes no sense to execute the CBA in painstaking detail.

As in most CBA's the following tasks had to be performed:

- Project description and other definitions (base case, project lifetime, stakeholders);
- Identification of relevant project effects;
- Estimating relevant exogenous developments, influencing types and magnitudes of project effects;
- Estimating the project effects over the project life span;
- Estimating investment and dismantling costs;
- Producing a cost-benefit set-up;
- Variant, risk and sensitivity analysis.

The structure of the CBA is summarized in Figure 2.1. The case of investing in a delayed coker (Case 4a) is used as an example.

Figure 2.1 Structure of the CBA procedure



The economic CBA of the refinery project for the island of Curaçao consisted of the following main steps.

For a proper economic assessment of the impact of the strategic options, available to RdK with respect to ISLA, one has to look first at the annual advantages and disadvantages for every party of each option (here the delayed coker case). These (dis)advantages are defined as differences between the annual development during the life span of the refinery in each option and the annual development in the base case (i.e. a continuation of the current situation until 2019, immediately followed by closure and a ten year period of dismantling of installations and site cleaning).

The next step consists of attaching a monetary value to all these advantages and disadvantages. For many items the monetary value is not very difficult to determine (e.g. work opportunities for ISLA employees and for contract workers hired by ISLA). Other effects of the strategic options, however, are more difficult to quantify or/and express in money terms (e.g. hindrance of residential groups by pollutants, noise or stench, or the value increase of the refinery site after closure and site cleaning).

The third step is to aggregate the monetary values of each of these items over all island individuals and groups who experience them and to calculate the annual net benefit for the island as a whole.

The final step consists of weighing the aggregate annual benefits with a proper discount rate, and to sum all yearly weighted net benefits (the further ahead in the future a benefit, the lower its relative weight in the present value). The net present value (NPV) is used as the overall assessment criterion.

2.3 Research Steps

2.3.1 Definitions

The project

The project is defined as the sum of all resources (investments) which contribute to the realization of the aims (preserving commercially viable refinery activities on Curaçao during the next decades), under the proposed preconditions (e.g. production according international environmental standards, and no financial losses to RdK or the island government). In fact, there are three project variants, or strategic options, designed (see section 3.3): the minimum investment case (Case 1), the delayed coker case (Case 4a), and the gasification case (Case 5a). The cases differ with respect to the amount of total investment, the assumed investment period, and the expected period of productive operations (the economic lifetime).

As two of the options (Cases 4a and 5a) span an estimated production period from 2007 till 2032, after which a ten year dismantling period is assumed to take place, all calculations run from 2007 till 2042.

N.B.

- A basic assumption underlying this CBA is that the strategic options 1, 4a and 5a, selected by RdK and taken from the P&G market outlook analysis, should be considered as technically and financially feasible and commercially viable;
- It should be remarked that in the economic CBA no attention was paid to investment alternatives of a comparable cost amount (i.e. non-refinery investments, e.g. investments in the touristy industry) on the ISLA site or elsewhere on the island.

The base case or 'without' case

A CBA can be characterized as an *incremental* or marginal approach: benefits, or welfare effects of the investments, are always defined as *differences* (advantageous or disadvantageous effects) between the development of a strategic option case with the development according to the base case. These differences are also called project impacts or intervention effects.

The base case is defined as the development which will take place if the present ISLA complex will continue its current operations until the year 2019. This operational period will be followed by a 10 year dismantling scheme. (See section 3.2)

In order to gain more insight in the total extent of the economic and environmental impact of the ISLA refinery this base case was not only used as the benchmark to estimate the effects of the three strategic options. The base case development with postulated closure in 2019 was also compared with an earlier closure (in 2010) to better depict the impact of a complete short term shutdown. This variant of the base case was called the premature closure case.

Stakeholders

Many parties will be involved in the investment, operational and the dismantling phases of the project variants as well as in the base case development. A distinction was made between island parties and foreign parties.

Foreign parties

The starting point of the analysis was that RdK will keep the ownership of the present refinery site at Scholtegat, but that there will be a foreign operator, who is assumed to be prepared to take care of the bulk of the necessary investments (presently PDVSA). Most costs and benefits of this foreign party are not relevant to island parties, and therefore to the CBA. In fact, only a minor part of the annual gross margin of the foreign operator (see sections 3.2.3 and 3.3.4) appears to be important, viz. the annual lease fee RdK receives. The same argument holds for foreign contractors who will provide the majority of the installations for each of the alternative strategic options. Their activities are only important for the CBA as far as they call in local island contractors or other island parties.

Island parties

On the other side due attention must be paid to all island parties who undergo advantages or disadvantages from the project. For the following parties effects were listed and assessed:

- Local refinery employees;
- Local employees of foreign and local contractors and suppliers;
- RdK as the refinery owner (itself a government owned company);
- The residential population downwind of the refinery (because of the air pollution damage);
- Other island parties, indirectly involved.

2.3.2 Assessment of relevant exogenous developments

In order to assess the sales of the project output and the effects on the welfare of island parties, sound assumptions in respect of changes in the environment of the project are required. As remarked earlier we take the results of the P&G market study for granted: the CBA is based on the assumption that the demand for the refinery products will be sufficient to guarantee the commercial profitability of the project (to PDVSA) under conditions of the present lease fee and production in line with international environmental standards.

There are, however, other exogenous factors to be taken into consideration. One of them is the macro-economic situation of Curaçao. If the island economy will be characterized by a low unemployment level, additional jobs arising out of a continuation or enlargement of refinery related activities will not lead to many additional jobs, but will extract workers from other activities on the island or attract foreign workers. If, on the other hand, the level of unemployment will be high, nearly all additional refinery related jobs may be fulfilled by unemployed workers from Curaçao, leading to higher benefits for the island.

To explore the range of possible welfare outcomes of the project an optimistic as well as a pessimistic employment scenario for the island economy was defined and used to calculate alternative macro-economic effects (see chapter 4).

2.3.3 Direct and Indirect Market Effects

The (positive and negative) benefits for the island stem on the one hand from effects with a market value (direct and indirect market effects), and on the other hand from (mainly negative) environmental effects of refinery activities on residents and other island parties which the perpetrator is not compelled to pay for (external effects, see next section).

Direct effects

Direct effects are related to the construction, operation and dismantling activities flowing from the project investment. How great the increase in welfare for individual parties will be, largely depends on the free market system. As a result of pressure from competitors, parties will eventually be forced to share their efficiency profits with others. In order to be able to calculate in advance what the demand for ISLA products would be, it is necessary to carry out a market and competition study.

As remarked above, for the CBA it has been explicitly assumed that the P&G study outcomes are considered as based on a sound market and competition analysis. Data on ISLA product assortment, operator turnover (volumes and values) by product type, investment by type & maintenance cost, operating costs (regarding labour, materials and other input), net profits before tax, etc. are therefore taken from this study.

Direct (or primary) effects are calculated by estimating the value added (VA) for Curaçao, realized by ISLA (investment and operations) and RdK (dismantling) as a consequence of implementing a strategic option and deducting the VA going with the base case.

The direct annual value added consists of the value of the output of the refinery minus the value of the inputs it purchases from other firms. Essentially it is the sum of the factor incomes, the wages and profits. For the economic CBA we use the difference of all the VA components of island parties.

Many activities caused by carrying out a strategic option involve the performances of contractors, hired by the operator or the owner of the refinery. The VA realized by contractors and their employees are actually secondary effects. For convenience such secondary effects are here considered also as direct effects.

These local VA-effects were estimated with the help of Curalyse, a macro-economic model tool, developed by the Government of Curaçao (see Chapter 5 as well as Annex A and C).

Indirect effects

The project does not only affect the VA of operator, owner and contractors and their employees, but can also have an impact on the rest of the economy. Indirect or higher order effects will, for example, also be perceived higher up or lower down in the production chain (backward or forward effects).

Opinions differ on the question whether an indirect effect implies only a redistribution of welfare among parties or leads to an increase in welfare. The answer depends on project-specific circumstances.

In this CBA indirect effects, calculated with the Curalyse model, were interpreted as having a welfare impact for the island.

2.3.4 External Effects

Annual air pollution effects

Another type of project impacts consists of externalities, caused by pollution and hindrance. They are valued by assessing the difference in annual damage, caused in each strategic option and the base case, and by estimating the market value of the damage to be prevented by implementing the option. In order to assess the environmental impact of the strategic cases one would preferably dispose of the results of a sound environmental impact assessment. However, such information was not available at the time of this CBA. It was therefore to resort to sometimes rough approximate calculations.

The way the external effects have been defined, estimated and valued is described in Annex B.

Although the refinery activities involve emissions of a variety of harmful substances, only two types of emissions were taken into account (SO_2 and PM10). Of the damage caused by both these substances only the health damage to humans was considered. The disutility of bad odours, visual landscape intrusion, harmful effects to property (e.g. corrosion) and to other living creatures (biodiversity) were all left aside. Health effects of SO_2 and PM10 were furthermore restricted to a limited number of illnesses.

These limitations in the approach followed was to an unknown degree compensated by choosing the high level health damage estimates as an acceptable range, and using the higher health cost estimate as the proper value standard (Annex B).

Depreciation/revaluation of the polluted site

The impact of removing existing refinery installations and cleaning the ISLA site after closing is only partly taken into account by assessing the VA-effects (section 2.3.3). However, the environmental improvement brought about - leading to more suitability of the site for other economic and social activities and to a reduction of damage to e.g. terrestrial and marine biodiversity – could not been specified and has consequently not been valued. As far as such effects will occur on the (very) long term, this omission has probably no serious consequences (the present value will be relatively low). For the base case and the premature closure case, however, the impact may not be negligible, which may have led to an undervaluation of benefits.

2.3.5 Project costs

The costs of the project alternatives involve investment costs during construction, operation expenditures during the life span of the project, and the costs of removal and site cleaning or change of destination (in so far as these are not attributed to the new destination).

Not all these costs, however, are costs made by island parties. Therefore, many of these items do not appear in the economic CBA-framework. The costs for Curaçao are restricted to outlays by island parties (mainly the owner RdK) for their share in investments on the one hand, and removal and cleaning operations on the other hand.

2.3.6 Cost-benefit set-up

After completing the steps described above, a business and social profitability analysis can be carried out. A business profitability analysis (for the operator) has been skipped, as this task was carried out in the pre-feasibility study by Purvin and Gertz. However, their results are used here as an input (see Chapter 3). The P&G information is important because it indicates to what extent a project variant is attractive to private investors.

In order to determine the economic profitability, all annual monetized benefits and disbenefits for all parties in the island economy are consolidated. The net present value (NPV) can then be calculated. The effects which cannot be expressed in monetary terms shout in principle be presented as PM-items (see Chapter 5).

2.3.7 Variant and risk analysis

Like all ex ante economic appraisal studies this CBA involves all kinds of risks and uncertainty. Structural uncertainty is partly dealt with by introducing an optimistic and pessimistic macro-economic employment development scenario for the island (section 2.3.2). Other ways to handle uncertainty is by carrying out sensitivity analyses.

For this CBA-analysis a variety of calculations were made, based on different assumptions regarding the question if RdK remains the owner of the refinery or if it will sell ISLA, the degree in which RdK – in case it will retain the ownership - participates in future investments, the equity share required in such a case, the discount rate used to calculate the net present value (NPV) of the annual costs and benefits, and finally with respect to alternative ways to estimate the damage costs of air pollution, caused by the refinery.

The following alternative assumptions have been specified and used in the 'basic variant' and a number of alternative calculation variants (sensitivity analysis; see section 5.4). If not explicitly specified, the results presented refer to the assumptions regarding the basic variant.

	Basic variant	Other variants
Re-employability of unemployed workers	Optimistic	Pessimistic
Sale of ISLA	No	Yes
RdK share in investment (case 4a and 5a)	10%	20%, 30%
Minimum prescribed RdK equity share	100%	40%
Pollution reduction impact (illness effects)	High estimation	Central, Low est.
Reduced health costs	High	Low
Removal and site cleaning	Both	Only removal
Social discount rate	10%	8%, 12%

The choice of a social discount rate is an important topic in CBA. In many countries some 4% is considered an acceptable *real* and *risk-free* discount rate, because it is based on the international capital market for risk-free long-term loans. However, given the pre-feasibility character of the P&G market analysis, and given structural weaknesses in the

island economy of Curaçao, the estimated costs and benefits are rather uncertain. As the assessment of the various types of risks could not adequately be dealt with during this pre-feasibility CBA, a social discount rate of 10% was chosen for the basic variant.

2.4 Cash Flow Analysis

The Purvin & Gertz study gives an insight in the business profitability of the strategic options for the operator of the refinery. It provides no information about the financial feasibility of the project cases seen from the viewpoint of RdK as the intended initiator of the project. Therefore, the possible implications of the financial position of RdK have been assessed for all strategic options in a provisional way (see chapter 6).

3 Base case and Strategic Options

3.1 Introduction

This chapter describes briefly the relevant data needed as an input for carrying out the economic cost-benefit analysis (CBA) for Curaçao as a whole for each strategic option compared to the base case (see for assessment methodology chapter 2). For each case the following information has been gathered:

- Data on operations, identifying financial flows from ISLA to the Curaçao economy as well as to abroad (i.e. foreign economies). This includes annual operational expenditures, annual shut down activities and annual gross margins;
- Data on total investments (if applicable), investment period and the share of local expenditures (assumed to be contracted to local contractors on the island);
- Data on SO_2 and PM10 emissions and ground level concentrations;
- Data on costs for removal of installations and site cleaning, which activities immediately will follow by any closure of the refinery and will cover a ten year period.

As already mentioned starting point for the CBA and thus for data gathering is the year 2007. Financial data are only presented for the short and medium term, because for each strategic option, annual operations costs have been calculated in the end in constant 2005-prices and are assumed to be constant over time since its first year of operation.

Because the economic CBA, calculating the change in welfare of the island, only takes into consideration direct and indirect advantages and disadvantages of the island economy, special attention is paid to the share of local expenditures in total investments, in annual operations and shut downs and in removal and cleaning costs. The levels of these local expenditures are the basic inputs needed for Curalyse (see section 2.3.3 and Annex C) to calculate the direct and indirect effects in terms of value added (VA), as one of the components in the CBA.

The calculated data on SO_2 and PM10 emissions and ground level concentrations are used to estimate the health effects associated with changes in air pollution and the related health costs (see Annex B5 and B6).

3.2 Base Case

3.2.1 Operations

The ISLA-refinery currently in operation is employing about 1,000 people (of which 4 expatriates) in the period 2007-2012. Annual operations (excluding buying feedstock and excluding annual shutdown activities) are estimated at NAF 288 million in 2007, increasing with less than 2% per year on average (up to 2012). About 90 percent of these expenditures will be directly spent in the local economy of Curaçao.

Table 3.1 Operations of ISLA refinery in Base Case (in million NAF, current prices)

	2007	2008	2009	2010	2011 *	2012 *
Refinery lease payment to RdK	32.2	32.2	32.2	35.8	35.8	35.8
Wages ISLA personnel, local	104.6	107.5	110.7	113.2	115.7	118.2
Contractors (wages and equipment**)	45.4	44.4	44.0	46.6	49.0	51.6
Other costs	25.4	26.4	26.8	26.8	26.8	26.8
Net payment ISLA to BOO	49.6	49.9	50.3	50.6	50.9	51.2
Total local expenditures	*257.2*	*260.4*	*264.0*	*273.0*	*278.2*	*283.6*
Foreign expenditures ***	30.7	31.5	31.9	30.1	30.5	31.0
Total expenditures ***	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

* Data for the period 2007-2010 are provided by Refinería ISLA (Curacao) SA. Figures for 2011 and 2012 are extrapolations made by ECORYS

** Excluding the so-called alíquota (i.e. reservation of money for maintenance purposes next year)

** Including wages expatriates

*** Excluding feedstock and excluding annual shutdown expenditures (see section 3.2.2)

Source: Refinería ISLA (Curazao) SA

According to contract with PDVSA the refinery lease payment to RdK amounts to NAF 32.2 million from 2005 on and will be increased after 5 years to NAF 35.8 million in 2010. However, up to 2019 (the year in which the contract will expire) the level of this lease payment (defined in current prices) will remain at the 2010-level.
From total local expenditures about 40 percent is meant for payment of salaries to ISLA personnel. Hiring local contractors for maintenance purposes (including equipment purchase) amounts to more than 17 percent. Other costs including local payments for medical services, port services, cleaning services, etc. amount to about 10 percent of total local expenditures. The remaining part consists of net payments from ISLA to BOO (ISLA paying for delivered electricity and receiving money for the supply of raw materials for the generation of energy).

3.2.2 Annual Shutdowns

Apart from day to day operations, every year shut down activities are planned, differing substantially from year to year. It has been estimated that about 90 percent of these activities will be contracted to local contractors.

Table 3.2 Annual expenditures for shut down activities (in million NAF, current prices)

	2007	2008	2009	2010
Local expenditures	19.26	20.43	32.13	42.03
Foreign expenditures *	2.14	2.27	3.57	4.67
Total expenditures shut down activities	21.40	22.70	35.70	46.70

* Foreign expenditures have been estimated at 10 percent of total expenditures

Source: Refinería ISLA (Curaçao) SA

For the years after 2010 it has been assumed that all shut down activities will be take place in the same order of magnitude (calculated at constant 2005-prices) as in the first four years.

3.2.3 Gross margin

Apart from annual operation activities as well as shut down activities, of which a substantial part is contributing directly and indirectly to the island economy, all financial flows related to inputs (feedstock like crude oil, etc.) and outputs of the refinery (refinery's output product mix) are not recorded in Curaçao and therefore not affecting the island economy at all, but are only fully benefiting PDVSA, the lessee of the refinery. However, to get a clear picture of all costs and revenues involved in the base case (and in the selected strategic options as well), estimates of the gross margin[2] provided by P&G are presented below and taking into account in our analysis.

Tabel 3.3 Gross margin Base Case

	2007	2008	2009	2010	2011	2012
Gross margin (USD million, current prices)	271	253	235	232	234	237
Gross margin (NAF million, 2005 prices)	463	424	386	373	366	362

Source: P&G/ECORYS

3.3 Cases 1, 4a and 5a

3.3.1 Investments

The investment costs for Case 1 "the minimum investment case" have been estimated by P&G at USD 303 million (2004 prices), of which about USD 150 million can be attributed to environmental investments (see also section 6.2). The investment period will last for two years starting in 2007[3]. In order to calculate the impact of those investments

[2] Gross margin is defined as total revenues from the product mix minus costs for feedstock

[3] In consultation with RdK the investment period has been set at two years, which differs from the investment period of three years set by P&G

on the island economy with Curalyse (see Annex C), local expenditures are estimated at 17.5 percent of total investments. These estimates are based on earlier experiences with IRUP and BOO investments and on capacity constraints of local contractors situated on Curacao (see table 3.4).

Table 3.4 Investment costs for Case 1

	total	2007	2008
Total investment (USD 2004-prices)	302.7	115.0	187.6
Total investment (NAF current prices)	587.5	220.2	367.3
Of which: local expenditures	*17.5%*	*38.5*	*64.3*
Of which: foreign expenditures	82.5%	181.7	303.0

Source: P&G/ECORYS

For Case 4a "the delayed coker case" and Case 5a "the gasification case" total investment costs have been estimated by P&G at USD 1.14 billion and USD 1.29 billion respectively (both 2004 prices). The investment period will last for about three years starting in 2009[4]. Also for these investments the share of local expenditures in total investment activities has been estimated. For both huge investments the local part is estimated to be 6 percent at a maximum, due to expected capacity constraints of local contractors (see table 3.5).

Table 3.5 Investment costs for Case 4a and Case 5a

	total	2009	2010	2011
Total investment Case 4a (USD 2004-prices)	1,144.2	171.6	457.7	514.9
Total investment Case 4a (NAF current prices)	2,348.9	343.3	933.9	1,071.7
Of which: local expenditures	*6%*	*20.6*	*56.0*	*64.3*
Of which: foreign expenditures	94%	322.7	877.9	1007.4
Total investment Case 5a (USD 2004-prices)	1,292.1	193.8	516.8	581.4
Total investment Case 5a (NAF current prices)	2,652.5	387.7	1,054.6	1,210.2
Of which: local expenditures	*6%*	*23.3*	*63.3*	*72.6*
Of which: foreign expenditures	94%	364.5	991.3	1,137.6

Source: P&G/ECORYS

3.3.2 Operations

From 2009 on, the level of operations activities for Case 1 only slightly differs from that of the base case. Based on information reported by P&G all relevant local expenditures as specified in the base case have been estimated in addition to the base case (see table 3.6). Total expenditures for the operator (i.e. local as well as foreign) estimated by P&G are not reported here (see report P&G), but directly taken into account in the overview of benefits and costs for the operator (see overview of results Annex D).

[4] In consultation with RdK the investment period of three years has been postponed with two years to 2009. This differs from the assumption made by P&G to start in 2007.

Table 3.6 Additional local operations expenditures Case 1, 4a and 5a (as % of the Base Case)

	Case 1	Case 4a	Case 5a
Wages ISLA personnel, local	+5%	+29%	+19%
Contractors (wages & equipment)	+6%	+42%	+53%
Other costs	+0%	+0%	+0%
Net payment ISLA to BOO	+0%	+0%	+0%
Refinery lease payment to RdK	+0%	+0%	+0%
Employment ISLA , local	*+5.5%*	*+35%*	*+23%*

Source: P&G/ECORYS

Compared to the base case, wages of ISLA personnel in case 1 will be 5 percent higher and contractor payments about 6 percent. The number of employees will increase with 5.5 percent. No significant change against the base case is expected for the other cost categories: this is also valid for the other strategic options.

For Case 4a and 5a with huge investment costs additional local expenditures are significantly higher compared to the base case. For Case 4a wages of ISLA personnel are 29 percent higher against the base case and the number of employees even 35 percent. For Case 5a, the number of employees are 23 percent higher, resulting in 19 percent higher wages against the base case. Contractor payments in Case 4a respectively in Case 5a are 42 and 53 percent higher compared to the base case.

3.3.3 Annual Shutdowns

With respect to the annual shutdowns, no detailed information is available for case 1, 4a and 5a respectively. Therefore, the following assumption has been made: additional expenditures related to the annual shutdowns will develop in line with additional expenditures related to contractor services.

Table 3.7 Additional expenditures on annual shutdowns (as % of the Base Case)

	Case 1	Case 4a	Case 5a
Annual expenditures (local + foreign)	+6%	+42%	+53%

Source: P&G/ECORYS

3.3.4 Gross margin

For Case 1 the gross margin hardly differs from the base case: on average the gross margin is expected to improve with only NAF 18 million (constant 2005 prices) annually. For Case 4a and 5a the improvement of the gross margin is substantial, about NAF 340 and NAF 300 million respectively (in constant 2005 prices) compared to the base case. On the other hand, both investment costs and operational costs also increased significantly. However, according to P&G both strategic options are commercially and financially viable.

Table 3.8 Change in gross margin for case 1, 4a and 5a, compared to the Base Case (in NAF million, constant 2005 prices)

	2009	2010	2011	2012
Case 1 Change in gross margin (NAF million 2005 prices)	+7	+20	+21	+18
Case 4a Change in gross margin (NAF million 2005 prices)	n.a. *	n.a. *	n.a. *	+343
Case 5a Change in gross margin (NAF million 2005 prices)	n.a. *	n.a. *	n.a. *	+303

* n.a.= not applicable

Source: P&G/ECORYS

Figures of the gross margin for all cases will directly be taken into account in the overview of benefits and costs for the operator (see overview of results Annex D).

3.4 Emissions and ground level concentrations

Based on the methodology presented in Annex B, SO_2 and PM10 emission levels as well as ground level concentrations (based on Cas Chikitu) have been calculated for all alternative cases[5]. The results are presented in Table 3.9, column 2. The strategic options (case 1, 4a and 5a) lead, in comparison with de base case, to a substantial reduction of SO_2 emissions levels, and - to a lesser extent – to a reduction of PM10 emissions.

Table 3.9 SO_2 and PM10 emission and ground level concentrations for each of the alternative cases

	ISLA emission levels	Cas Chikitu ground level concentration		
		all sources	ISLA sources	other sources
	t/d	µg/m³	µg/m³	µg /m³
SO_2				
ground level concentration standard		*80*		
alternative cases:				
ISLA closed	0,0	44	0	44
Base case	143,0	117	93	24
Case 1	97,0	84	60	24
Case 4a	92,0	82	58	24
Case 5a	94,0	72	48	24
PM10				
ground level concentration standard		*40*		
alternative cases				
ISLA closed	0,0	38	0	38
Base case	3,3	90	52	38
Case 1	2,5	77	39	38
Case 4a	2,5	78	40	38
Case 5a	1.0	55	17	38

Source: Environmental Impact Note, Selwyn Maduro (TSP-levels converted to PM10 concentrations)

The ground level concentration figures for Cas Chikitu (which was considered representative for all areas affected) were derived from the ISLA emission levels by using

[5] Environmental Impact Note, prepared by RdK.

the procedure followed in the 2001 Tebodin/Tauw report, which makes a distinction between the contributions to the ambient air quality from the refinery and from other sources.

The Base Case emission levels represent the current operation. According to the figures presented SO_2 and PM10 ground concentration levels in the representative area exceed the existing standards. Case 1 leads to an improvement in terms of emissions despite an increase in fuel consumption (from 436 to 592 t/d). Installation of three flue gas scrubbers leads however to a reduction of the sulphur content of emissions as well as to capturing of particulate matter at 90% efficiency. The expected ground level concentrations remain nevertheless higher than the standard.
In Case 4 the sulphur content of the residual fuel oil, used in the refinery furnaces, is assumed to be reduced from 3,5% to 0,2%, while the sulphur content of coke and fuel consumption by utility boilers also diminishes. With a total fuel consumption of 483 t/d used in the refinery furnaces, this implies a small further reduction of SO_2 emissions. The content of PM10 in this case is lower than in the base case because of the blending of low sulphur distillates in the residual fuel oil components. The ground level concentrations in the Cas Chikitu area of both types of emissions will not be different from the situation in Case 1. In Case 5 the SO_2 emissions are approximately at the same level as in cases 1 and 4. However, the SO_2 produced in case 5 is dispersed at a higher elevation than in the former cases due to rationalization of the utility complex. The virtual stack height increases with some 20 meters, causing a significant decrease in SO_2 and PM10 concentrations in the ambient air of the representative residential area. In Case 5 the contribution of ISLA to the total concentration of PM10 in the area decreases to even less than one third (17 $\mu g/m^3$ on a total of 55 $\mu g/m^3$).

3.5 Removal and Cleaning Program

In the event of a complete shutdown of the refinery operation and subsequent closure of the ISLA plant in Curaçao, the land on which the refinery is constructed might be used for other purposes. To realize this objective, a removal and cleaning program has to be set up and to be carried out within a timeframe of 5 to 10 years.

For the purpose of this strategic study a first rough estimate of both the removal and cleaning costs of the refinery installations and grounds have been made, based on information collected by RdK and set down in the "Refinery clean-up document" dated 27th of June 2005[6] (which will be reported here to a large extent).

Total removal costs
In the event of a cessation of operation the installation will be removed. An estimate has been provided by the leading demolition contractor KdK in Curaçao. This estimate is cursory and no rights can be obtained from it, but it can be used in this analysis. Total costs of removal of the refinery are estimated at USD 310 million. The duration of the

[6] "Refinery Clean-up Document", 27th of June 2005, RdK.

- The refinery area will be developed as an industrial area; in this estimate the basic infrastructure cost will be taken into account.

The new insight in remediation techniques (isolation rather than full excavation and back fill) represents significant cost savings. It is estimated the proposed plan will result in a cost which is 20 percent of the conventional technique. Total remediation (or site cleaning) costs are estimated in this way at about USD 85.5 million. A breakdown is presented in table 3.11.

Table 3.11 Site cleaning costs ISLA refinery (in USD million, 2005 prices)

Activity	USD million
500,000 m3 of fill @ NAF 30 per m3	8.5
Rainwater collection header	10.0
50 check wells @ NAF 4,000 each plus equipment	1.0
Small Waste Water Treatment plant	10.0
Waterfront repairs	20.0
Basic infrastructure for 500,000 m2 @ NAF 50 per m2	14.0
Consultancies, contingencies and overhead @ 35%	22.0
Total site cleaning costs	85.5

Source: RdK and Vectis BV /Stern Milieutechniek

However, it should be stressed here that the estimate of the site cleaning costs is very conservative (based, as already mentioned on isolation techniques) and has to be seen as an absolutely minimum. More thorough estimates are needed as soon as is known what activities will possibly be established on (part of) the refinery area in the very future.

Total removal and site cleaning costs

For the purpose of this strategic study we can appreciate that the estimated cost for removal and site cleaning is in the order of magnitude of about USD 400 million (=NAF 720 million, 2005 prices). Although the time frame in which both activities might be accomplished is 5 to 10 years, our starting point in the CBA is a duration of 10 years. Therefore, annual removal and site cleaning costs are calculated at an average of NAF 72 million (2005 prices).

4 Macro-Economic Development of Curaçao

4.1 Introduction

In this chapter the economic development of Curaçao in the recent past and the expected development on the short and medium run will be described. Economic development data are based on Curalyse, a macro-economic model built in 1995 and 1996 by the Department of Economic Affairs (DEZ) in close co-operation with Micromacro Consultants, and operational since 1996. This model is updated every year and for this strategic study in particular, the model is extended to 2012 in stead of 2008[8] in order to give some insight in the economic developments in the short and medium run. Moreover, the extension of the model give us also the opportunity to estimate the annual contribution of the ISLA refinery to the local island economy for the Base case (since 2007) as well as for the strategic options selected after implementation of each of the accompanying investments (see Annex C and D), being operational from 2009/2012 onwards.

The national economic development will be expressed in the macro-economic indicators GDP and labour market. These two indicators are selected due to their significance in the effect calculation of the strategic options for the refinery, to be used in the CBA. Relevant information on other indicators like export, import, consumption, gross investments, balance of payments, etc. is presented in Annex A.

Long run economic development expectations for Curaçao (up to 2025 or thereafter) are not available. However, some qualitative information will be needed on the two macro-economic indicators mentioned above (GDP and the labour market) in order to carry out the CBA for all alternatives, concerning the period up to 2032/2042. This will be briefly dealt with in the last section of this chapter.

4.2 Economic development during the recent past

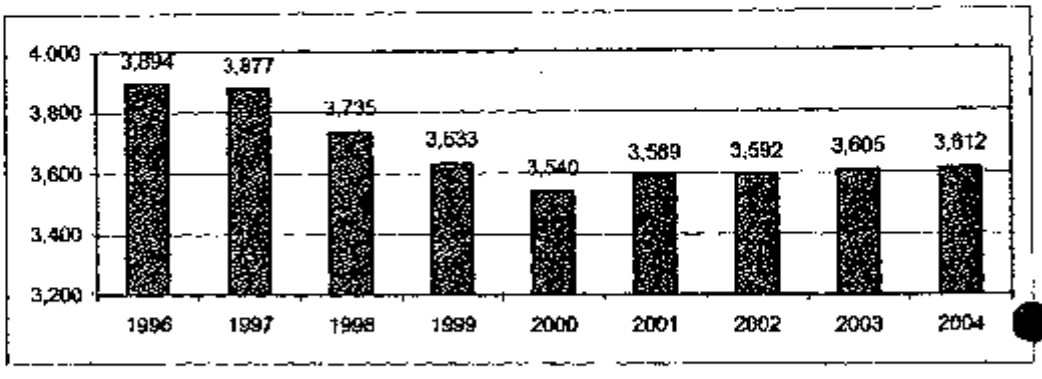
Curaçao is a typical small island economy. It has a total land area of 44 square kilometres and a population of 135,110 in 2004. Natural resources are limited and the distance to export and import markets are considerable. Almost all consumer and capital goods are imported.

[8] DEZ stressed that the assumptions made as well as the economic scenarios calculated only have to be seen as reference growth paths, and not as exact predictions of the local economy up to 2012. The main objective was to use these growth paths for estimating the effects of different configurations of the ISLA refinery on the island economy.

GDP

In 2004 real GDP in Curaçao (calculated in 2005-prices) is NAF 3.612 million. The real GDP increased for the fourth successive year after a decline in the period 1996-2000.

Figure 4.1 Development of Real GDP (2005 prices) in million NAF, 1996-2004



Source: Curalyse

2004 is an estimate

The decline in real GDP in the period 1996-2000 amounted to 9 percent. This decline is mainly attributed to a decrease in domestic demand caused by declining consumption (minus 12 percent) and investments (minus 8 percent). Changes in levels of import (minus 11 percent) and export (minus 7 percent) result in the fall in real GDP as well. After this decline the real GDP increased in the period 2000-2004 with 2 percent because of an increase in consumption and export of respectively 3 and 4 percent, and a decrease in import and investments of respectively 8 and 3 percent.

The labour market

After a decrease of the population during the period 1996 to 2001, population increased to 130,400 inhabitants in 2004. Net emigration decreased from 5,500 persons in 1996 to zero in 2004. About 45 percent of the population is part of the labour force. The Curaçao labour market can be characterised by high unemployment, the unemployment rate amounted to 16.0 percent in 2004.

Table 4.1 presents an overview of the developments of the population size, net migration, labour force, number of unemployed and the unemployment rate during the period 1996-2004.

Table 4.1 Developments in the Curaçao labour market

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Population (x 1,000)	146,3	146,1	141,9	136,7	131,3	126,8	129,9	133,6	130,4
Migration balance (immigration = -) x 1,000	5,5	6,4	5,6	5,6	6,6	5,1	2,0	0,0	0,0
Labour force (x 1,000)	66,1	61,1	61,2	56,3	54,0	53,2	53,8	57,7	58,8
Number of unemployed (x 1,000)	9,3	9,5	10,2	8,8	7,6	8,4	8,4	8,7	9,4

Source: Curalyse

2004 figures are projections made with the model Curalyse

4.3 Expected economic development on the short and medium run

In the light of the current economic developments as described in the previous section, the following three growth paths have been chosen: a trend, optimistic and pessimistic growth path. These paths have been drafted for the period 2005-2012 in close co-operation with DEZ and mutually agreed upon, using their macro-economic model "Curalyse". Please refer to Annex C for a description of Curalyse.

In the trend growth path it is assumed that the Curaçao economy will continue along the path of last years. Additional investments made in the context of the Multi-Year Economic Program 2004-2007 (MEP) and the restructuring of the investment climate as proposed are not included.
In the optimistic growth path it is assumed that 75 percent of the projects part of the MEP is implemented in 2004 increasing to 95 percent of the projects in 2012. About 75 percent of these projects should be tourism projects. Out of development funds, NAF 25 million will be available for economic development on annual basis. In addition the island government will finance NAF 5 million yearly.
In the pessimistic growth path the MEP and OECD policies will not be carried out and the government will not implement the proposed measures for improving the investment climate. As a result, the tourism sector will show a smaller growth compared to the baseline scenario, hotel projects will not be implemented and the labour productivity will not improve. Private investments will decrease because of a lack of confidence in the government.

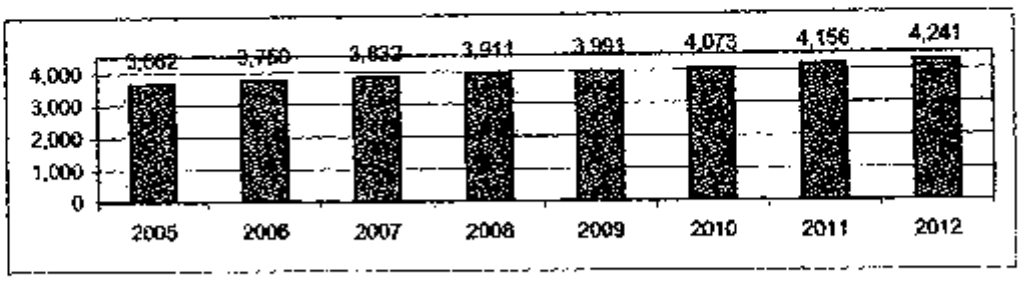
Table 4.2 presents an overview of the assumptions and differences between the three growth paths.

Table 4.2 Overview of assumptions growth paths

	Trend	Optimistic	Pessimistic
Migration balance (immigration = -) (number of persons yearly)	0	-500	1,500
Export excl. tourism (yearly growth)	0%	+1%	-0.5%
Tourism (yearly growth)	+5%	+7% (+5% 2005)	+ 1%
Investment government (yearly)	Yearly NAF 23 million	Yearly NAF 28 million	NAF 23 million in 2004 Yearly -2%
Investments companies (yearly)	Yearly NAF 40 million	2005: NAF 30.7 million 2006: NAF 41.3 million 2007: NAF 62.2 million 2008: NAF 61.2 million	Yearly NAF 15 million

Trend growth path
In the trend growth path GDP is expected to increase from NAF 3,662 million to NAF 4,241 million in the period 2005 to 2012. The real GDP growth is mainly caused by an expected increase in consumption, investments, export and import.

Figure 4.2 Development in real GDP in NAF million (2005 prices), trend growth path 2005-2012



Source: Curalyse

According to the trend growth path population will increase from 131,800 to 142,300 people in the period 2005 to 2012. The migration balance will be 0 persons. The labour force is expected to be 45 percent of the population. The unemployment rate will slowly decrease from 17.5 percent in 2005 to 14.6 percent in 2012.

Table4.3 Developments labour market baseline scenario, 2005-2012

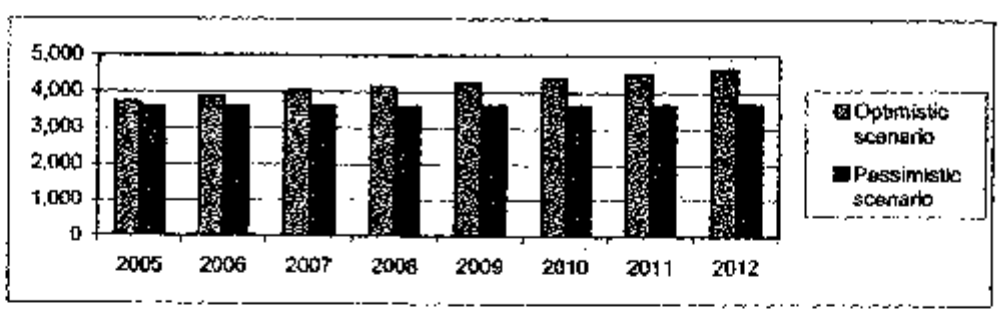
	2005	2006	2007	2008	2009	2010	2011	2012
Population (x 1,000)	131.8	133.3	134.8	136.2	137.7	139.3	140.8	142.3
Migration balance (immigration = -) x 1,000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labour force (x 1,000)	59.0	59.9	60.6	61.4	62.2	63.0	63.7	64.5
Number of unemployed (x 1,000)	10.3	10.0	9.9	9.8	9.7	9.6	9.5	9.4

Source: Curalyse

Optimistic and pessimistic growth path for the period 2005-2012

Figure 4.3 presents the increase in real GDP for both the optimistic and pessimistic growth path. In the optimistic growth path GDP increases from NAF 3,719 million in 2005 to NAF 4,636 million in 2012. In the pessimistic growth path, GDP increases from NAF 3,569 million in 2005 to NAF 3,656 million in 2012.

Figure 4.3 Developments in real GDP (NAF million, 2005 prices), optimistic and pessimistic growth path, 2005-2012



Source: Curalyse

In the optimistic growth path GDP total growth between 2005 and 2012 is 24.6 percent. These growth figures are caused by increased investment (26.3 percent), increased consumption (27.0 percent) and increased exports and imports (34.7 and 26.3 respectively). In the pessimistic growth path GDP will only increase with 2.5 percent. This small growth is caused by an increase of exports (8.5 percent) and mitigated by an

increase in investment and imports of respectively 1.2 percent and 0.6 percent and a decrease of consumption (minus 1.4 percent).

In the optimistic growth path labour force will improve significantly compared to the situation in 2005 with more than 13 percent, but in the pessimistic growth path it will hardly change. The unemployment rate in the optimistic scenario will decrease from 17.1 percent in 2005 to 12.4 percent in 2012. In the pessimistic growth path the unemployment will only decrease from 17.9 to 16.1 percent. An overview of all labour market indicators under the three scenarios is presented in table 4.4.

Table4.4 Developments labour market in optimistic and pessimistic growth paths 2005-2012

Growth path		2005	2006	2007	2008	2009	2010	2011	2012
Optimistic growth path	Population (x 1,000)	132.3	134.3	136.3	138.3	140.3	142.3	144.4	146.5
	Migration balance (immigration = -) x 1,000	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50
	Labour force (x 1,000)	59.3	60.6	61.7	62.8	63.8	64.9	66.0	67.1
	Number of unemployed (x 1,000)	10.1	9.6	9.2	9.0	9.0	8.8	8.6	8.3
	Unemployment rate (%)	17.1	15.8	14.8	14.4	14.1	13.5	13.0	12.4
Pessimistic growth path	Population (x 1,000)	130.3	130.3	130.2	130.1	130.1	130.0	129.9	129.9
	Migration balance (immigration = -) x 1,000	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
	Labour force (x 1,000)	58.2	58.3	58.3	58.3	58.4	58.4	58.4	58.5
	Number of unemployed (x 1,000)	10.4	10.1	10.0	9.9	9.8	9.6	9.5	9.4
	Unemployment rate (%)	17.9	17.2	17.1	17.0	16.7	16.5	16.3	16.1

4.4 Long Run Economic Scenario

As already mentioned in the introduction of this chapter, no long run economic development expectations for Curaçao are available. However, because the CBA will be carried out in constant 2005 prices and no real significant changes in annual effects being expected from 2012 onwards, it is only needed to estimate qualitatively the growth rate of GDP as well as the related development in the labour market (in particular the migration balance and unemployment rate).

In the long run optimistic economic scenario real GDP will continue to grow (possibly at a lower rate than in the period 2005-2012, being 3.2 percent annually), leading to a more diversified local economy with a significant role for economic activities like tourism. In this scenario it is assumed that the migration balance will be influenced positively leading to a significant net immigration of people and a significant lower unemployment rate. In this optimistic scenario, most of the people can easily find new jobs. Based on this positive development it has been assumed that in case of a closure of the refinery in 2019 or 2032 from the people being directly or indirectly unemployed (except people older than 60 years) in any case about 75 percent will get a new job within 2 years time.

In the long run pessimistic economic scenario, real GDP will hardly grow (like in the period 2005-2012, being 0.35 percent annually), leading to a weak local economy with

hardly any job opportunities. In this scenario it is assumed that unemployment rate will remain high and emigration of people will continue. Based on this very slow economic development it has been assumed that in case of a closure of the refinery in 2019 or 2032 from the people directly or indirectly being unemployed (except people older than 60 years) only 25 percent will get a job within 2 years time and most of the remaining people will leave the island soon.

5 CBA Impact of Strategic Options and Premature Closure

5.1 Introduction

Based on the methodology and research steps presented and discussed in chapter 2, the various inputs described in chapter 3, all value added (VA) effects calculated with Curalyse (see Annex C) as well as the health effects (see Annex B), the CBA has been carried out for three strategic options and the premature closure case (all compared to the base case). The main results are presented below. First a picture is shown of total net benefits for the island of Curaçao for all four cases, followed by a breakdown into four main categories of effects. Next, special attention is briefly paid to the external effects. Finally, the results of the sensitivity analyses are discussed followed by some conclusions. Detailed information of all results is presented in Annex D.

5.2 Total Net Benefits for the island of Curaçao

The basic variant of the CBA (see also section 2.3.7) rested on the assumption that RdK remains the owner of the refinery and participates for only 10 percent in new investments (case 4a and 5a)[9]. Moreover this variant is characterized by the assumption that the equity capital of RdK will not be shared by other parties. Finally, it is based on an optimistic scenario for re-employment of workers after closure of the refinery and on combining a high estimate of health effects with high unit cost calculations.

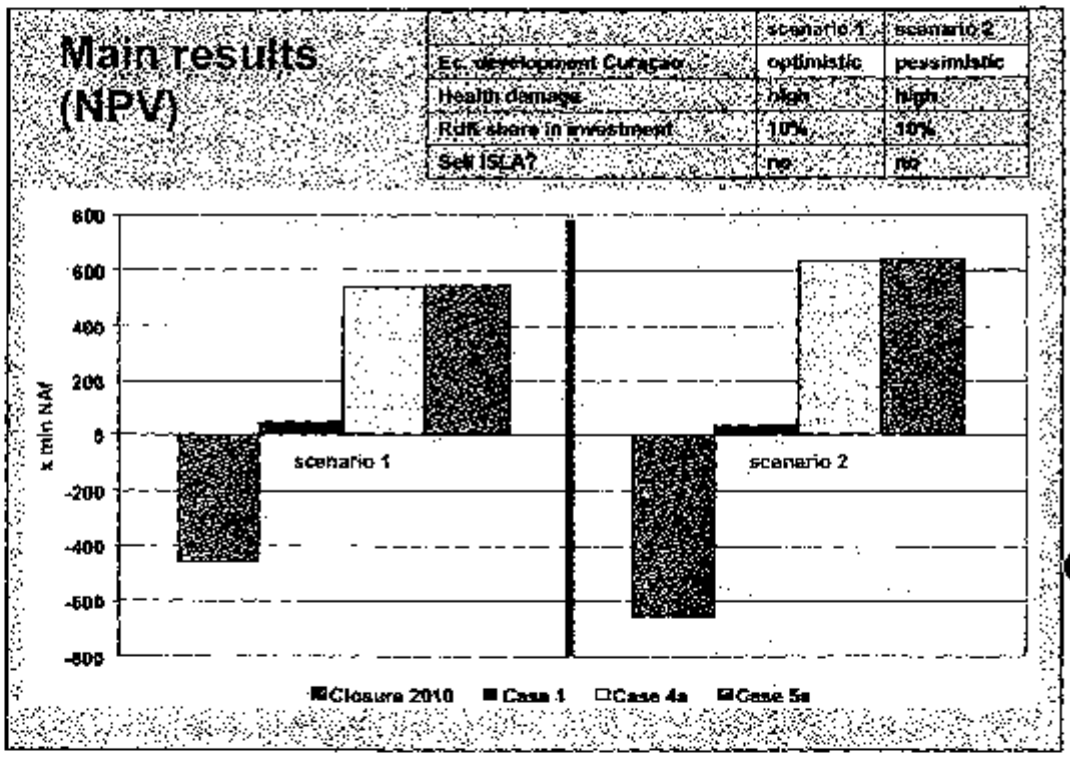
If not explicitly specified, the results presented below refer to these assumptions regarding the basic variant. Of course, as already discussed in section 2.3.7, a variety of calculations based on different assumptions with respect to the elements mentioned above were made. The results of these analyses are presented briefly in section 5.4.

For the four cases selected (each compared to the base case development) the net present value (NPV) in 2005 of the expected annual economic costs and benefits during the period 2007-2042 is presented in Diagram 5.1. The left hand side presents the expectations in case of an 'optimistic' view on the capacity of the local economy to quickly absorb local workers, becoming unemployed after the refinery closes down (2019

[9] For case 1 RdK is participating obligatory for 50 percent in the environmental part of the investment (which is nearly equal to 25 percent of total investment)

in Case 1; 2032 in cases 4a and 5a, and 2010 in the premature closure case). The results corresponding with the pessimistic scenario are shown at the right side of the diagram. The diagram shows that the minimum investment case (case 1) has no net advantage for the island, compared with the base case (continuation of the present situation). Premature closure is very unfavourable in comparison with the base case. Both the delayed coker (case 4a) case and the gasification (case 5a) case however are advantageous. The net costs (of the premature closure case) but also the net benefits (of the cases 4a and 5a) will be higher in the pessimistic scenario. In the closure case Curaçao will be confronted with a higher unemployment figure on the very short term (i.e. from 2010 on, compared with the base case, where unemployment of ISLA workers and related local personnel will be postponed till 2019); in both modernization cases unemployment will appear much later (2032) than in the base case. The start of the unemployment period has an important influence on the net present value of the annual wage sum.

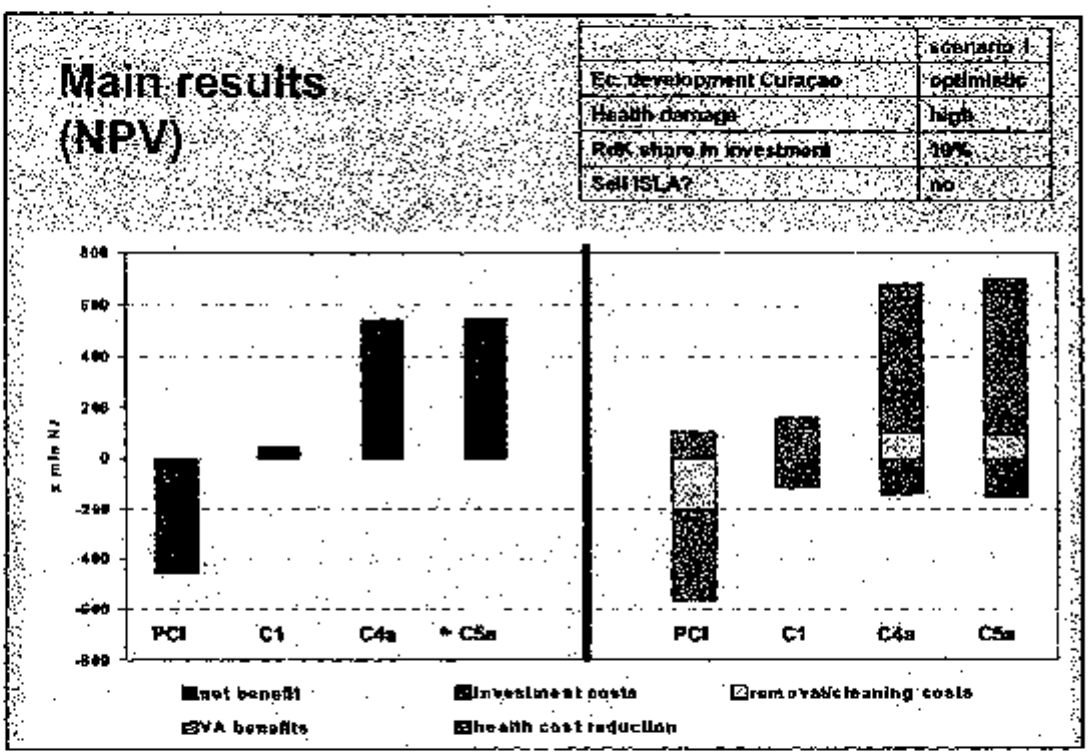
Diagram 5.1 Total net benefits for Curaçao of strategic options and premature closure



In Diagram 5.2 for the optimistic re-employment scenario the NPV of the net benefit per case are presented on the left side, while the right side shows a limited breakdown of the net benefit into four main categories:

- (Net) investment costs, needed to realize cases 1, 4a and 5a, respectively (in fact: the difference between investment costs in each strategic case and in the base case);
- (Net) costs of removing the installations after closing the refinery, and of site cleaning;
- (Net) value added, directly or indirectly realized by island parties resulting from investment and operation activities, removal and cleaning expenditures;
- (Net) value of health cost savings, arising from the emission reduction of harmful substances.

Diagram 5.2 Breakdown of total net benefits per case



All three strategic cases offer more *value added* than the base case. The difference in this type of benefit is highest for cases 4a and 5a, because in both these cases operations will continue till 2032. Premature closure (PCI) in 2010, however, leads to a substantial welfare loss in comparison with the base case (closure in 2019).

Cleaning and removal costs are also relatively high in the PCI-case for the same reason. This type of costs is not relevant for case 1, because the assumed closure takes place in the same year as in the base case.

Investment costs differences are absent in the premature closure case. The highest investment costs are found in cases 4a and 5a.

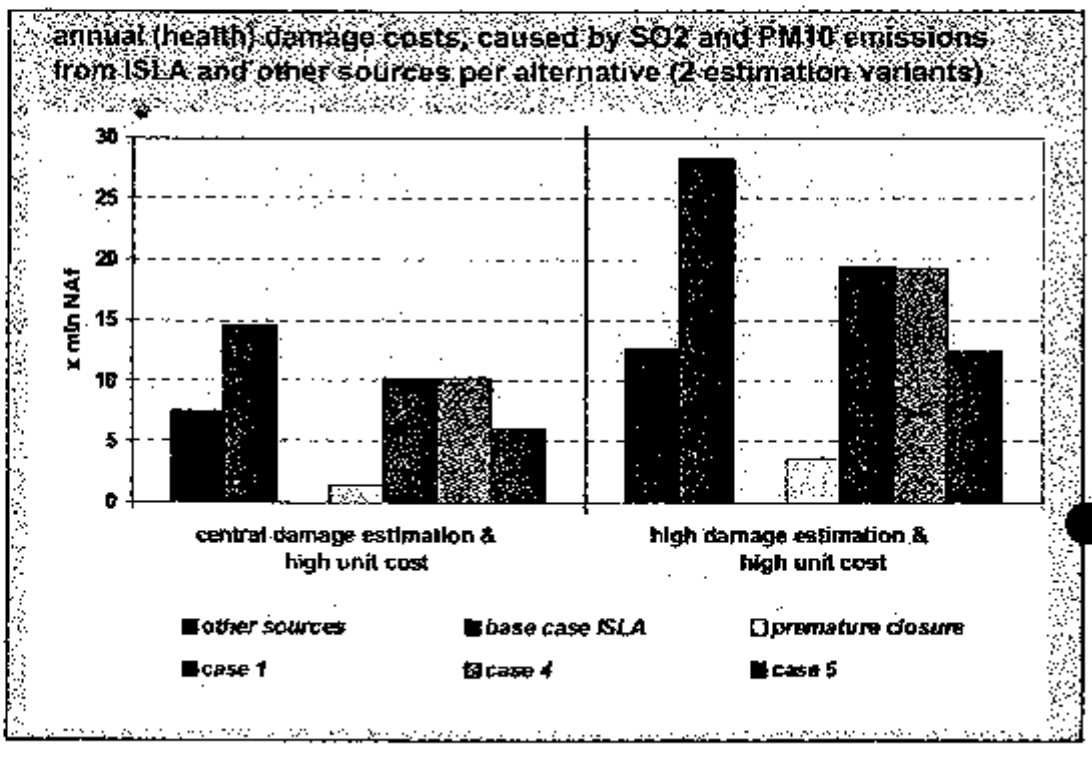
Regarding *health cost change* the largest difference with the base case occurs in the early closure case. The reason is of course the complete stop of harmful refinery emissions. Noticeable is the lack of net health damage reduction in case 4a (delayed coker case). Although the ground level concentrations of SO_2 and PM10 in this case are lower than in the base case (see Table B.2 in Annex B), the period during which the pollution continues will be much longer for this modernization case (the refinery closes in 2032 instead of 2019).

For more detailed information on the CBA results of the basic variant (including optimistic as well as pessimistic re-employment scenario) is referred to Annex D, table 1 and 2.

5.3 External Effects as part of total net benefits

Diagram 5.3 offers a look at the *total annual* environmental costs, which have been approximated by assessing health costs for a limited number of illnesses, caused by only two of the harmful substances emitted by ISLA (SO_2 and PM10). The diagram presents the results for the central and high damage estimates, combined with the high health unit cost variant (see also section 2.3.4 and Annex B). For only two types of pollutants and only the health damage caused by these substances were quantitative data available. To compensate for the resulting underestimation of the environmental impact, it was decided to use the high health damage estimate and high health unit cost as input for the CBA in the basic variant (presented at the right side of Diagram 5.3). According to the variants presented the annual damage will decrease in all project cases (compared to the base case). Case 1 and case 4a show the same level of damage, while case 5a displays a lower health cost amount.

Diagram 5.3 Annual health cost savings per alternative option



5.4 Sensitivity Analysis

Besides the basic variant a variety of calculations were made based on different assumptions regarding the question if RdK remains the owner of the refinery or if it will sell ISLA, the degree in which RdK – in case it will retain the ownership - participates in future investments, the discount rate used to calculate the net present value (NPV) of the annual costs and benefits, and finally with respect to alternative ways to estimate the damage costs of air pollution, caused by there refinery. The main results in terms of total net benefits are presented in the next tables. Calculations referring to variations in the

equity share, required in case RdK will retain the ownership of the refinery, are discussed in the next chapter.

Table 5.1 Calculations based on a variety of assumptions with respect to economic growth path, health costs, share of RdK in new investments and sales to ISLA or third parties (for each strategic option and premature closure compared to the base case)

Island of Curaçao	Economic growth path	Health cost estimation	Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
10% share RdK in investments (4a & 5a)	Optimistic	High	-475	46	550	554	1311
	Pessimistic	High	-671	38	645	651	1185
	Optimistic	Central	-524	23	546	532	1410
	Pessimistic	Central	-721	15	641	629	1284
20% share RdK in investments (4a & 5a)	Optimistic	High	-475	46	410	396	1311
	Pessimistic	High	-671	38	506	493	1185
	Optimistic	Central	-524	23	406	375	1410
	Pessimistic	Central	-721	15	501	471	1284
ISLA sold to PDVSA	Optimistic	High	-475	46	1120	1142	1311
	Pessimistic	High	-671	38	1215	1239	1185
	Optimistic	Central	-524	23	1115	1120	1410
	Pessimistic	Central	-721	15	1210	1217	1284
ISLA sold to Third Party	Optimistic	High damage	-475	46	1355	1377	1311
	Pessimistic	High damage	-671	38	1450	1474	1185

All results for each of the strategic options as well as for premature closure are presented as compared to the base case (which is separately shown in the last column). In the first three columns the chosen combination of assumptions is presented. In the upper row of the table (in yellow) the basic variant is presented again, for reasons of comparison.

The following remarks can be made:

- Compared with the basic variant a variant in which health costs are estimated based on central damage instead of high damage health effects shows a reduction of total health costs. As a consequence total health costs savings realized are lower in all four cases and therefore negatively affecting net benefits. In the premature closure case this is most significant (-50 million). In case 1 it is reducing the (very small) net benefit with at least 50 percent;
- Increasing RdK's share in new investments from 10 to 20 percent (only applicable in case 4a and 5a), directly leads to an increase of accrue total costs for the island (but

not its benefits) and therefore affects net benefits with some NAF -140 million and NAF -160 million in case 4a and 5a respectively;

- In case the refinery will be sold to PDVSA at an estimated sales price of USD 290 million (=NAF 520 million)[10] in 2008 (only in case continuation of operations after 2019 is guaranteed and based on upgrading the refinery according to new investments like case 4a and 5a), Curaçao is more or less doubling its net benefits (see case 4a and 5a). This is not only due to the high NPV of the sales revenues (= NAF 430 million), but also due to the savings in investment costs realized by RdK, because in this situation all new investments have to be done and financed by the new owner;
- In case the refinery will be sold to a third party at USD 450 million (=NAF 805 million)[11], based on the same conditions as stated above, the net benefits for Curaçao are about NAF 235 million higher (=difference between the NPV's of both sales prices).

Next to the variants presented above, some other sensitivity analyses have been carried out, keeping the basic variant as starting point.

Table 5.2 Calculations based on alternative assumptions with respect to total investment costs, demolition and site cleaning costs (for each strategic option and premature closure compared to the base case)

Island of Curaçao	Economic growth path	Investment costs	Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Investment costs in case 1, 4a, 5a (No VA effect contractors)	Optimistic	+ 20%	-475	23	522	523	1311
	Pessimistic	+ 20%	-671	14	618	620	1185
	Optimistic	-20%	-475	70	578	586	1311
	Pessimistic	-20%	-671	61	673	683	1284
Demolition, no cleaning costs	Optimistic		-460	46	542	546	1322
	Pessimistic		-656	38	638	643	1199
Demolition + Cleaning costs+300%	Optimistic		-505	46	566	570	1289
	Pessimistic		-701	38	661	667	1163

In all cases:

- 10% share RDK in case 4a and 5a;
- high health costs estimation.

From the table above the following remarks can be made:

[10] Sales price is based on estimates made by P&G recently. For selling the refinery to PDVSA, the value of the refinery is based on cash flows.

[11] For selling to third parties, the sales price (estimated by P&G) is valued at comparable sales.

- Increasing or decreasing investment costs with 20 percent hardly affect the net benefits for Curaçao. This is due to the fact that it is assumed that 90 percent of the investments will be paid by the operator (not taking into account in the CBA), and only 10 percent by RdK. It is also due to the fact that no change in value added (VA) is expected, because it is assumed that the capacity of local contractors will be used fully independent of the level of total investment costs;
- In case site cleaning costs are not taken into account, and only demolition activities will be carried out, also no significant change in net benefits for Curaçao can be expected. This is due to the fact that site cleaning costs are estimated very conservatively (and only amount to 20 percent of total demolition and site cleaning costs) and are spread over a period of 10 years;
- Even in case site cleaning costs are estimated at a 300 percent higher level, no significant change in net benefits for the island can be expected.

From the variety of calculations made it can be concluded that the overall picture that premature closure is very unfavorable, case 1 has no net advantage and both cases 4a and 5a are advantageous (all in comparison with the base case) is robust.

Finally, a sensitivity analysis has been carried out changing the social discount rate from 10 percent to 12 and to 8 percent in the basic variant.

Table 5.3 Sensitivity analysis based on changes in social discount rate (basic variant, optimistic economic scenario) for each strategic option and premature closure compared to the base case

Island of Curaçao	Economic growth path	Health cost estimation	Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Discount rate 8%	Optimistic	High	-534	63	731	734	1512
Discount rate 12%	Optimistic	High	-423	33	419	424	1155

Changing the social discount rate from 10 to 12 or to 8 percent of course implies a significant impact on the net benefits of all four cases. However, as concluded before the overall picture that premature closure is very unfavorable, case 1 has no net advantage and both cases 4a and 5a are advantageous (all in comparison with the base case) remains still valid.

5.5 Conclusions

Total net benefits (net present value difference with base case):

- Early closure of the refinery (around 2010) is definitely not an economic option; although the net present value of health cost savings for this alternative are higher than for all three other cases considered, this benefit will not counterbalance the loss of value added;

- Case 1, the 'minimum investment case' with an accent on environmental investments and refinery closure in 2019 appears also not to be a favorable economic option. The net benefit (compared to the base case) is negligible;
- Both, case 4a and 5a investments on the other hand, will result in a comparable amount of net economic benefits for Curacao. As the analysis carried out here is based on a provisional market outlook, and because the CBA itself was also in some respects characterized by rather rough approximations, more detailed and accurate analyses are desired, before concrete decisions should be taken.

Environmental (health) effect:

- Annual environmental damage, in terms of health cost saved, is - according to the high damage, high unit cost estimation - in case 4a more than NAF 9 million and in case 5a nearly NAF 16 million lower than the base case (base case health damage level: some NAF 28 million a year).

6 Impact on Financial Position of RdK

6.1 Current and future financial position of RdK without investments obligations

Based on information provided by RdK on the current financial position and its short term obligations, its cash balance for the period starting with 2007 up to 2031 has been estimated in 2005 prices. The cash balance at the 1st of January 2007 has been estimated at NAF 125.8[12] million increasing to NAF 442 million in the end of 2018 (base case and case 1) and to NAF 725 million in the end of 2031 (case 4a and 5a). However, be aware that those figures are excluding any possible obligations on removal and site cleaning after closure of the refinery, nor obligations of participating in new investments. This forecast is based on the following assumptions:

- Continuation of the present lease fee construction paid by PDVSA (fixed at the 2010 price level) up to 2019 (in the base case and case 1) and up to 2031 (in case 4a and 5a);
- Continuation of dividend from preferred equity (up to 2018);
- Continuation of the interest on loans up to 2019 and 2031 respectively;
- Continuation of operational expenditures of RdK up to 2019 and 2031 respectively.

From the figures presented above, we can conclude that in the base case (in which no new investments will be done by RdK) the cash balance of NAF 442 million (2005-prices) at the 1st of January 2019, is far from sufficient for financing the removal and site cleaning costs estimated conservatively at NAF 720 million (in 2005-prices) to be spread over a 10 years period (see section 3.5).

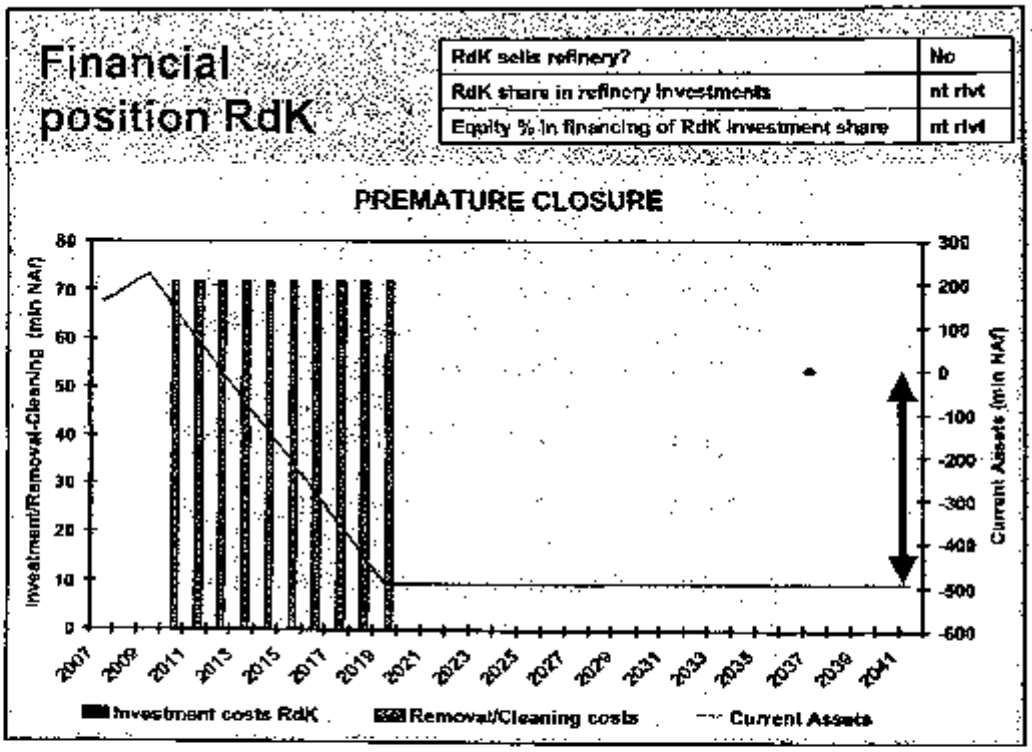
In the next section the impact of the strategic options on the financial position of RdK will be dealt with. For case 1 the share of RdK in new investments is already fixed (at 50 percent of the environmental part of the investments, based on the lease contract concluded with PDVSA). For the other strategic options no agreements have been made yet.

[12] In 2007 it is assumed that NAF 71 million will be spent for investments in WWTP; only in case of premature closure in 2010, investments in WWTP will be cancelled.

6.2 Impact of Strategic Options on financial position of Rdk

Calculations show that just like in the base case (see section 6.1), in case 1 and especially in the premature closure case the asset position of RdK will be far from sufficient to fulfill its obligations in the medium and long run. Diagram 6.1 depicts the financial position of RdK for the premature closure case.

Diagram 6.1 Current asset position of RdK and expected expenditures 2007-2020 of premature closure case



From the diagram it becomes clear that closure of the refinery in 2010, leaving an asset position of NAF 224 million (2005-prices), is far too low to finance the removal and site cleaning activities to be started immediately after closure. It ends up in a negative asset position of some NAF 500 million in 2020.

In case 1 "the minimum investment case" with an accent on environmental investments, for 50 percent to be financed by RdK (= about 25 percent of total investments), RdK is not only facing problems in the long run, but also in the short run in case the investments are financed with 100 percent equity (see diagram 6.2): in 2008 the cumulated cash balance is NAF -17 million. Only if 40 percent is based on equity and 60 percent on debt financing, RdK's financial problems in the short run are solved, but will increase significantly in the long run.

Diagram 6.2 Current asset position of RdK and expected expenditures 2007-2029 of case 1 (100 percent equity)

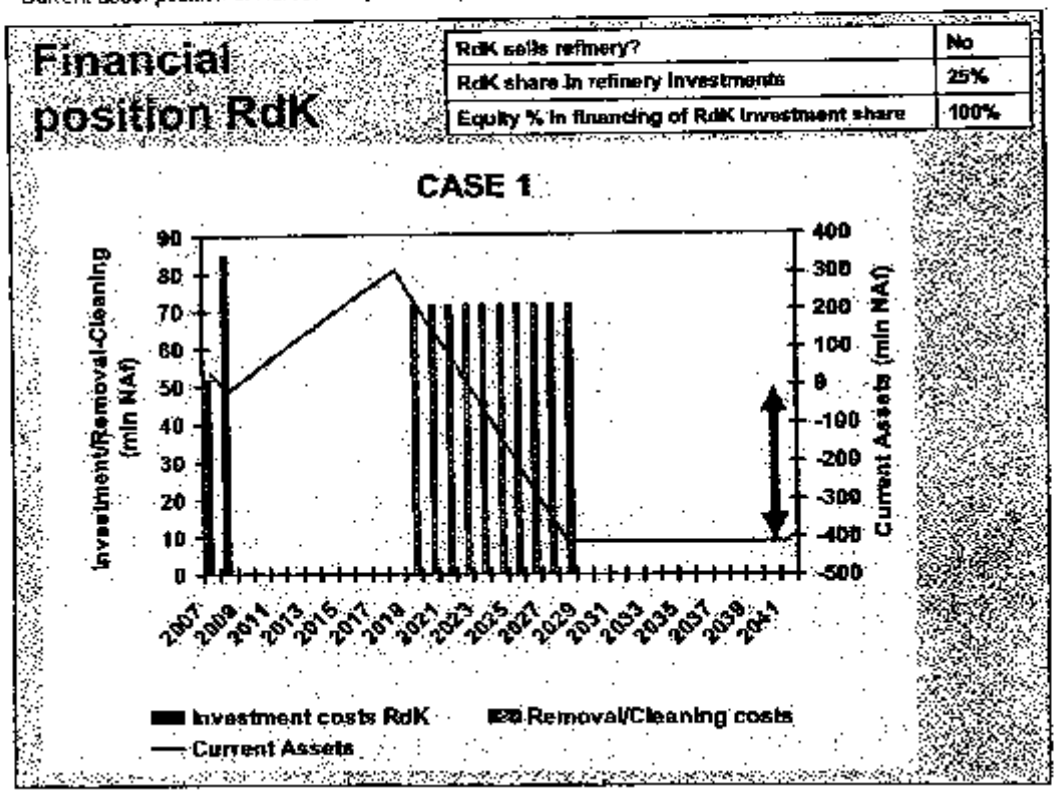
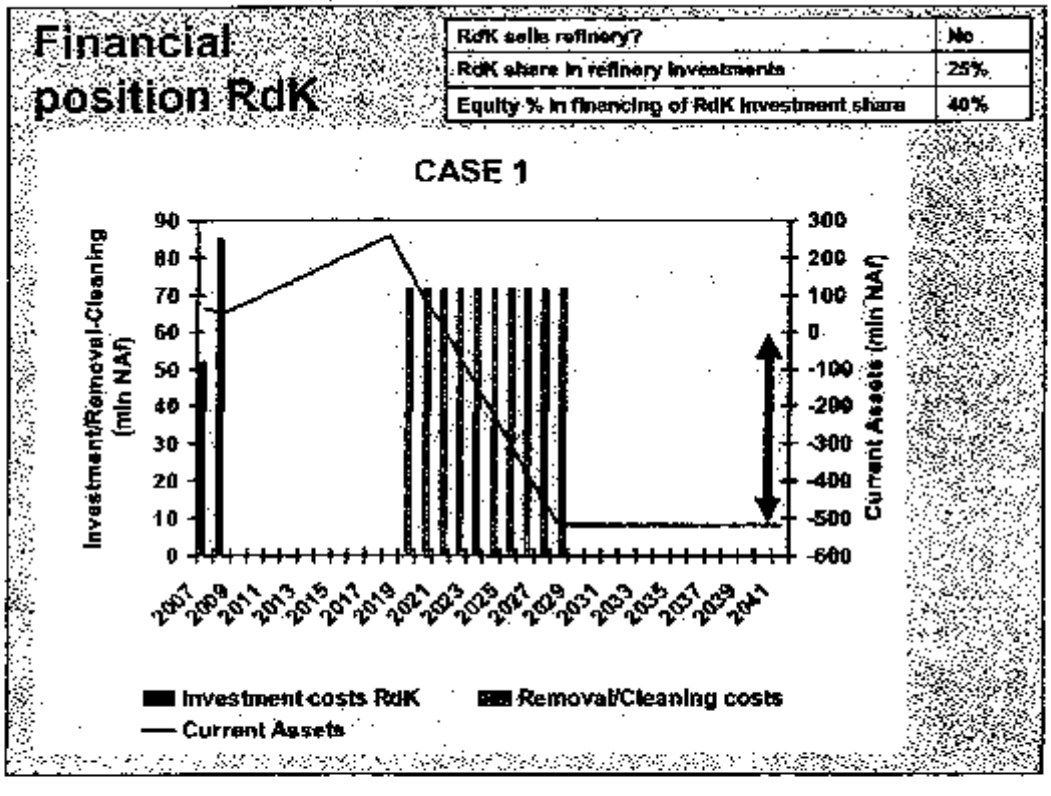


Diagram 6.3 Current asset position of RdK and expected expenditures 2007-2029 of case 1 (40 percent equity)



Case 4a and case 5a

The basic variant of the cost-benefit calculations rested on the assumption that RdK remains the owner of the refinery and participates for only 10% in new investments. This variant is further characterized by the assumption that the equity capital of RdK will not be shared by other parties (obligatory 100% equity share).

Given the investment programs, corresponding with the cases 4a and 5a, the question rises how the obligation to participate in new investments influences the asset position of RdK on the short and on the long run. Will RdK be capable to participate in the investment program for the years 2009 to 2011, and if so, will RdK - given the existing lease fee amount - be able to restore its asset position, so that it can finance a satisfactory 10 year removal and site cleaning operation at the end of the operation period?

The answer to this question for the basic variant is dealt with in two parts. First, the long run results will be discussed briefly, based on a 10 percent share and 100 percent equity financing for both case 4a and 5a, followed by an overview of variations in investment share and equity share for case 4a. Second, the short run results will also be presented based on case 4a using two options for both the investment share and equity share.

Financial position on the long run

In the next diagrams the long run financial position of RdK is shown for case 4a and 5a.

Diagram 6.4 Long run asset position of RdK at case 4a

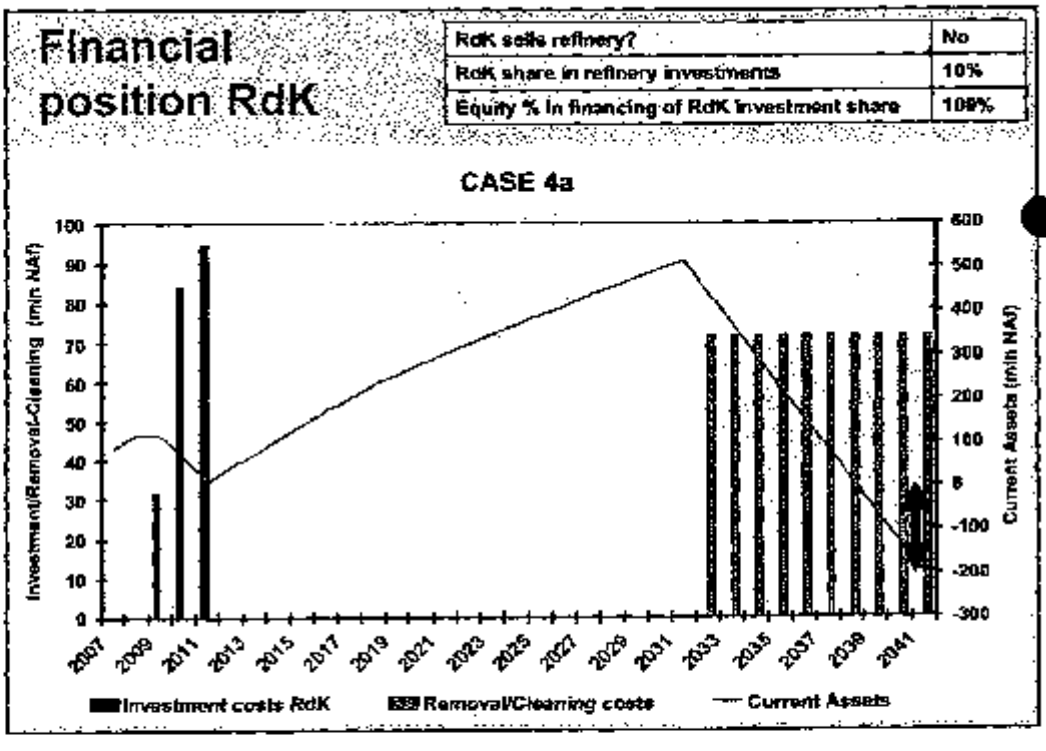
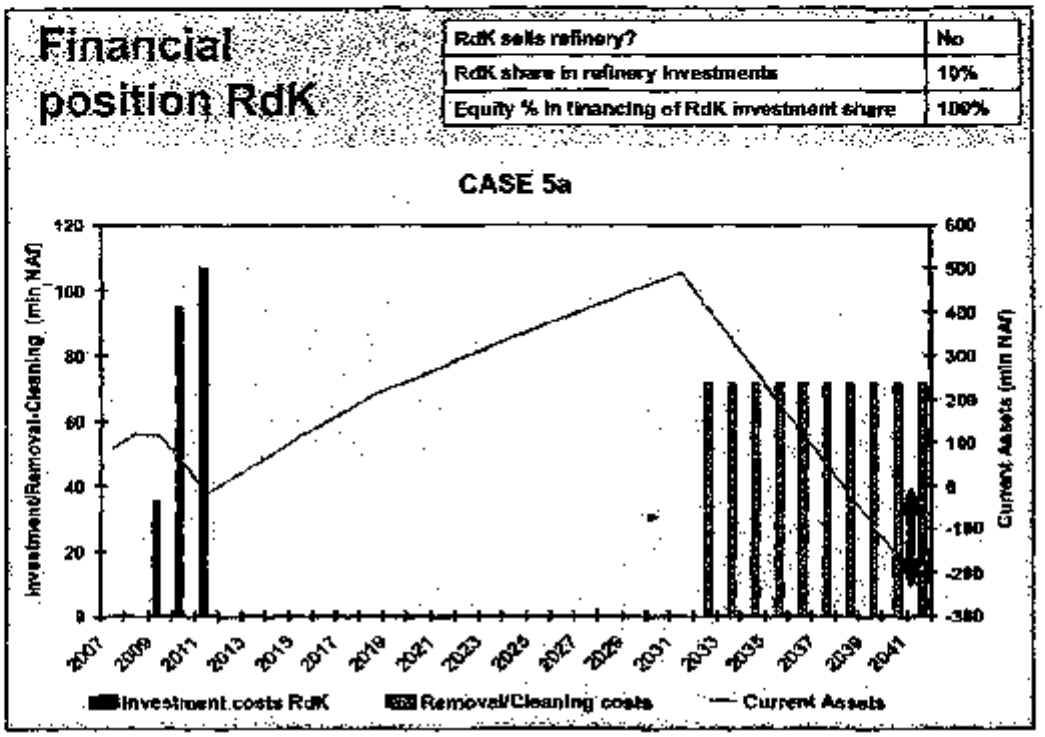


Diagram 6.5 Long run asset position of RdK of case 5a.



The continuous red line (cumulative asset balance) in both diagrams shows that RdK in 2007 will start with a moderate current asset position (some NAF 100 mln; see right axis), but that the investment obligation between 2009 and 2011 (brown columns; left axis) nearly depletes the asset supply (see for more details next diagrams presenting short run results for case 4a). After 2011 the flow of lease fees restores the asset position, until from 2033 on yearly removal and site cleaning expenditures (blue columns) will again diminish the existing stock. It becomes clear from both diagrams, that this time RdK will be confronted with a lack of funds to finance the expenditures of the last three years.

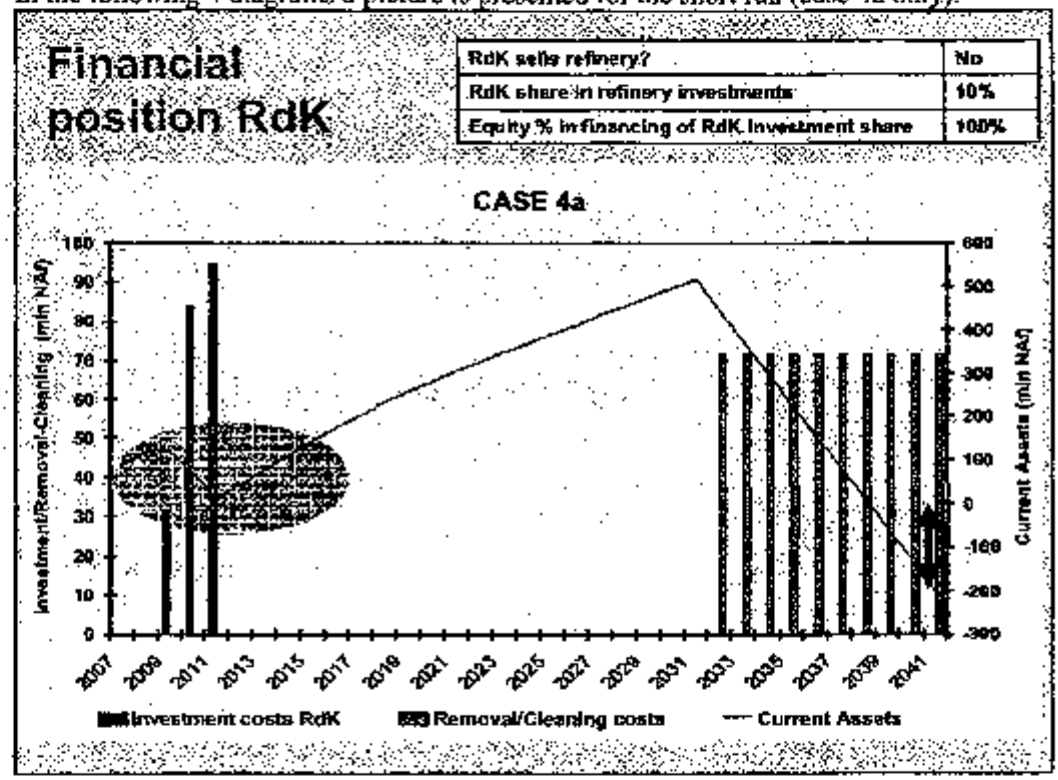
In the next table is shown how the financial position of RdK changes with variations in the investment share and in the equity share (for case 4a only, to be used as an example).

Table 6.1 Asset position of RdK (NAF million) in the long run for some financing variants (Case 4a)

Cumulative asset balance	Equity share RdK	RdK share in investment		
		10%	20%	30%
Prior to removal/cleaning:	40%	350	- 35	-410
year 2032	100%	515	305	95
Including removal/cleaning:	40%	-370	-750	-1,130
Year 2042	100%	-200	-410	-620

It can be concluded that under all circumstances considered the asset position is not sufficient to finance the minimum necessary expenditures for removal and site cleaning. If RdK would switch to pay dividends to its (government) owner in the short run, it would be forced to borrow funds to fulfill its investment obligations. In the long run this will have as a consequence that the lack of funds for removal and site cleaning after operations will increase substantially.
Concerning the share of RdK in new investments, it becomes clear that a 30 percent share is not an option at all, and even a 20 percent option is not very realistic.

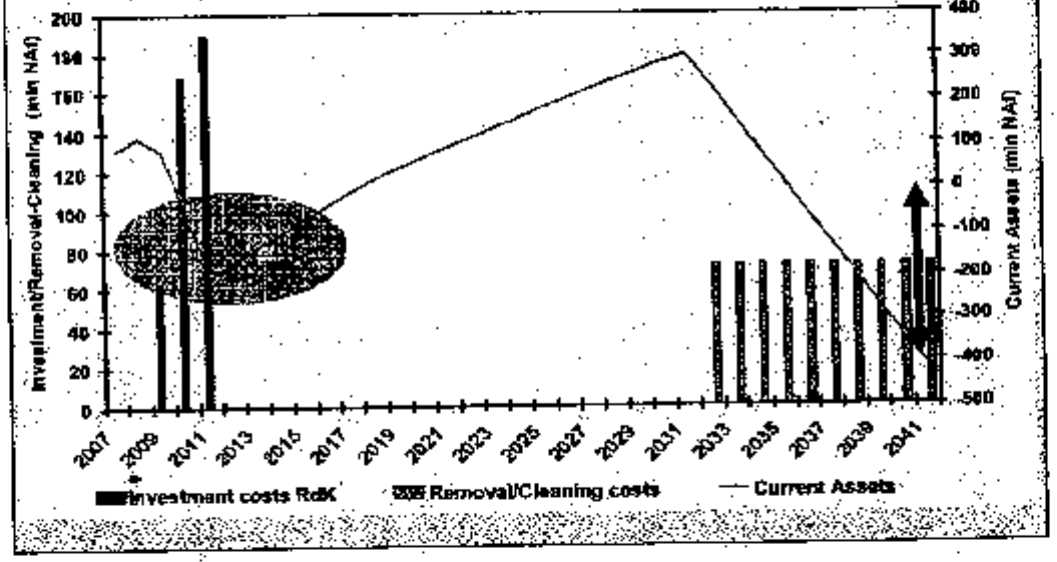
Financial position on the short run: case 4a
In the following 4 diagrams a picture is presented for the short run (case 4a only).



Financial position RdK

RdK sells refinery?	No
RdK share in refinery investments	20%
Equity % in financing of RdK investment share	100%

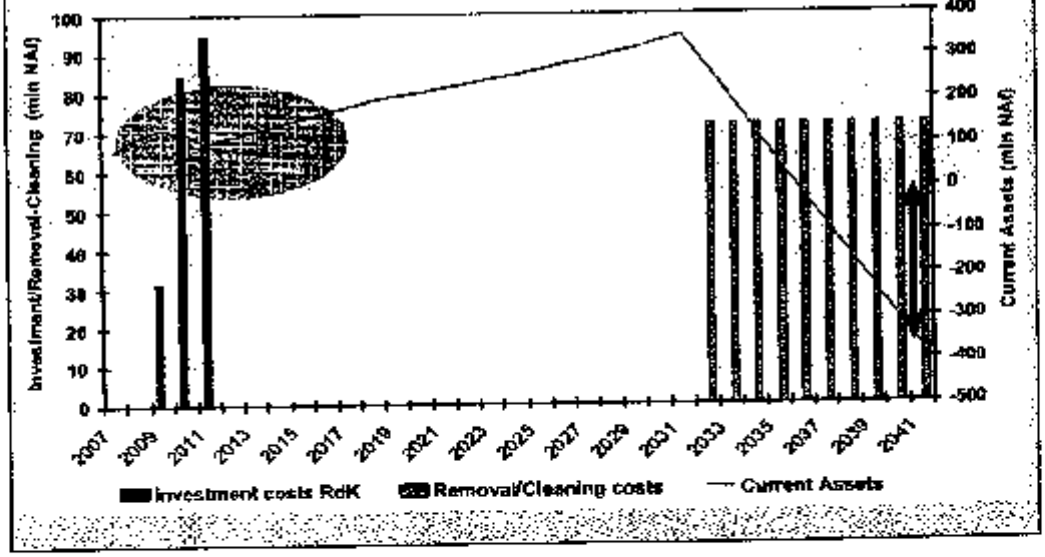
CASE 4a

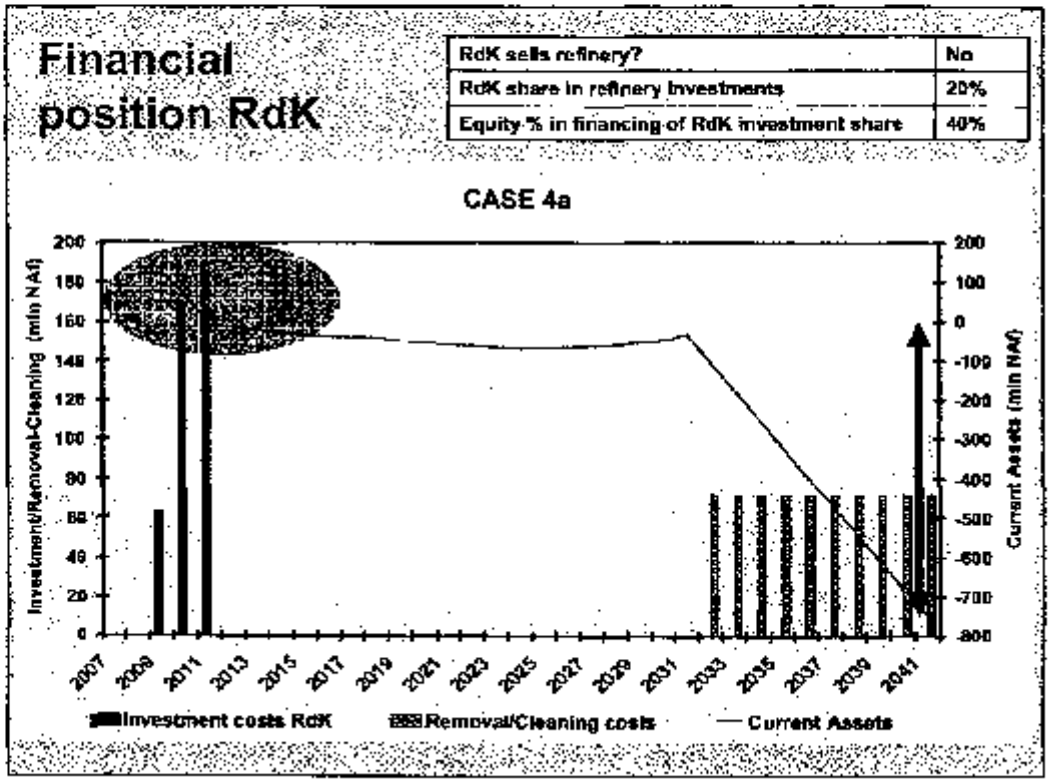


Financial position RdK

RdK sells refinery?	No
RdK share in refinery investments	10%
Equity % in financing of RdK investment share	40%

CASE 4a





Again like in the previous diagrams, the continuous red line (cumulative asset balance) in all four diagrams shows that RdK in 2007 will start with a moderate current asset position (some NAF 100 mln; see right axis), but that the investment obligation between 2009 and 2011 (brown columns; left axis) nearly depletes the asset supply. In case RdK's share is 10 percent and is financed with 100 percent equity the cumulated cash balance in 2011 is still positive (NAF 9 million), which is the lowest level reached in the short and medium run. With a share of 20 percent and equity is 100 percent, the cumulative cash balance becomes negative for the first time in year 2010 with NAF -45 million, and NAF -210 million in 2011. After that RdK's income is slowly restoring the asset position which becomes positive for the first time in 2018. If RdK is forced to borrow (because of paying dividend's to the Government), and equity is only 40 percent, this gives some room for paying dividend's, because the cumulative cash balance is NAF 106 million at the lowest in 2011, when the share of RdK is 10 percent in new investments. Its consequence is, as said before, that the long run asset position is negatively influenced and becomes about twice as much at the end of the period in 2042, compared to 100 equity financing. In case RdK's share is 20 percent and equity 40 percent, the cumulated cash balance becomes negative in 2011 (NAF -8 million), staying negative in the whole period thereafter up to 2031 (NAF-33 million), and finally (because of removal and site cleaning activities) 10 years later resulting in a very negative asset position of about NAF -750 million.

In case the refinery will be sold to PDVSA (at an estimated sales price of USD 290 million (=NAF 520 million) in 2008, the cumulated cash balance at the end of 2008 will become NAF 688 million (2005-prices) and NAF 811 million in 2031, leaving sufficient room for financing all removal and site cleaning activities, ending up in 2042 with an asset position of NAF 161 million. Sales to third parties (see section 6.4) will even strengthen the asset position, assuming a higher sales price.

6.3 Conclusions

- The financial position of RdK does not offer much room for a (10% or higher) contribution to large investments in ISLA (such as in case 4a and 5a). All the more not, if RdK has the obligation to remove the ISLA installations after closure and to clean the refinery site;
- Removal & cleaning costs after closure will represent a huge burden for RdK/Curacao. In case of closure in 2010 or 2019 the existing assets are insufficient. Reservation of funds is inevitably required if removal and cleaning should be carried out from 2032 onward;
- A win-win situation might be possibly achieved by selling the refinery and by using the money gained for new investments in profitable alternative activities in Curacao, in order to put aside part of its returns for the realization of the removal & cleaning activities needed.

7 Conclusions

The results of the analysis presented before lead to a number of important conclusions.

Total net benefit (net present value difference with base case):

- Early closure of the refinery (around 2010) is definitely not an economic option: although the net present value of health cost savings for this alternative are higher than for all three other cases considered, this benefit will not counterbalance the loss of value added;
- Case 1, the 'minimum investment case' with an accent on environmental investments and refinery closure in 2019 appears also not to be a favorable economic option. The net benefit (compared to the base case) is negligible. Moreover, RdK is facing significant financial problems in the short run, in case 50 percent of the environmental investments are financed with 100 percent equity. Only if 40 percent is based on equity and 60% on debt financing, RdK's financing problems in the short run are solved, but will increase significantly in the long run;
- Both, case 4a and 5a investments on the other hand, will result in a comparable amount of net economic benefits for Curacao. As the analysis carried out here is based on a provisional market outlook, and because the CBA itself was also in some respects characterized by rather rough approximations, more detailed and accurate analyses are desired, before concrete decisions should be taken.

Environmental (health) effect:

- Annual environmental damage, in terms of health cost saved, is - according to the high damage, high unit cost estimation - in case 4a more than NAF 9 million and in case 5a nearly NAF 16 million lower than the base case (base case health damage level: some NAF 28 million a year).

Financial position RdK:

- The financial position of RdK does not offer much room for a (10% or higher) contribution to large investments in ISLA (such as in case 4a and 5a). All the more not, if RdK has the obligation to remove the ISLA installations after closure and to clean the refinery site;
- Removal & cleaning costs after closure will represent a huge burden for RdK/Curacao. In case of closure in 2010 or 2019 the existing assets are insufficient. Reservation of funds is inevitably required if removal and cleaning should be carried out from 2032 onward;
- A win-win situation might be possibly achieved by selling the refinery and by using the money gained for new investments in profitable alternative activities in Curacao, in order to put aside part of its returns for the realization of the removal & cleaning activities needed.

- All financial flows related to inputs and outputs of the refinery (now and in future) will only fully benefit PDVSA, the lessee of the refinery. Consequently all future investments of RdK related to the refinery are in principle non-profitable;
- Substantial investment efforts required from PDVSA (case 4a and 5a), assuming RdK's share will not be more than 10 percent of total investments, will have significant impact on the financial position of the operator (see Annex D), and therefore will result in less room for increasing the lease fee for RdK (in particular in case 5a).

Annex A Macro-economic development of Curaçao

A.1 The Curaçao economy in 2004 including recent developments

A.1.1. Introduction

Curaçao is a typical small island economy. It has a total land area of 44 square kilometres and a population of 135,110 in 2004. Natural resources are limited and the distance to export and import markets are considerable. Within the Caribbean, Curaçao belongs to the group islands with a relatively high per capita Gross Domestic Product (GDP), together with Bermuda, Puerto Rico and Aruba.

Because the natural resources are limited, almost all consumer and capital goods are imported. Venezuela and the USA are the major suppliers. With a share of imports in GDP amounting to 81 percent in 2004[13], Curaçao is considered to be a very open economy. The high amount of imports creates the need to earn foreign exchanges. Major foreign exchange earning sectors are transport, tourism and the financial offshore.

a)External shocks to the Curaçao economy

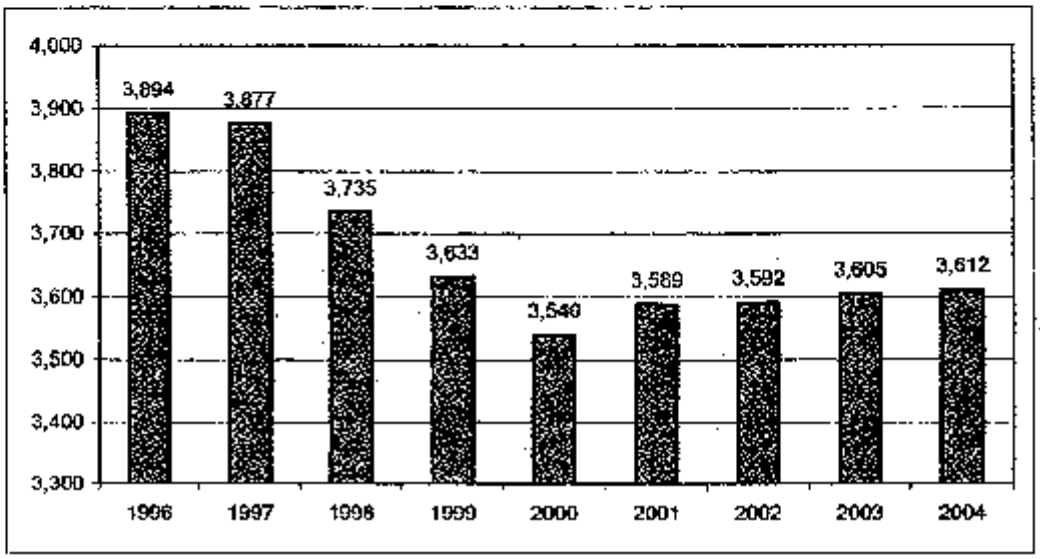
Over the past two decades, the Curaçao economy was hit by two shocks from which it has yet to recover. The biggest shock was the adjustment in the American tax treaty in 1986, which indirectly caused the collapse of a number of previously highly profitable offshore financial activities. These activities were also a significant source of Governments revenue and foreign exchange. The share in Government revenue accounted for by the offshore financial sector dropped from 60 percent in 1986 to 20 percent in 1999. Contributions of the financial offshore to the foreign exchange earnings fell from 27 to 14 percent over the same period. The second major shock was Shell's withdrawal, with all its personnel, from Curaçao in 1986 and the (temporary) closure of the oil refinery, which has been a mainstay for the Curaçao economy for almost three-quarters of a century. These adverse developments caused an economic depression in the 1983-1987 period. However the Curaçao economy recovered somewhat during the worldwide economic recovery in the late eighties and the boom in the tourist industry in the early nineties.

[13] Source: Curalyse

A.1.2. Macro-economic developments

In 2004 real GDP in Curaçao (calculated in 2005-prices) is NAF 3.612 million. Figure 1 presents the development of GDP in the period 1996-2004. The real GDP increased for the fourth successive year after a decline in the period 1996-2000.

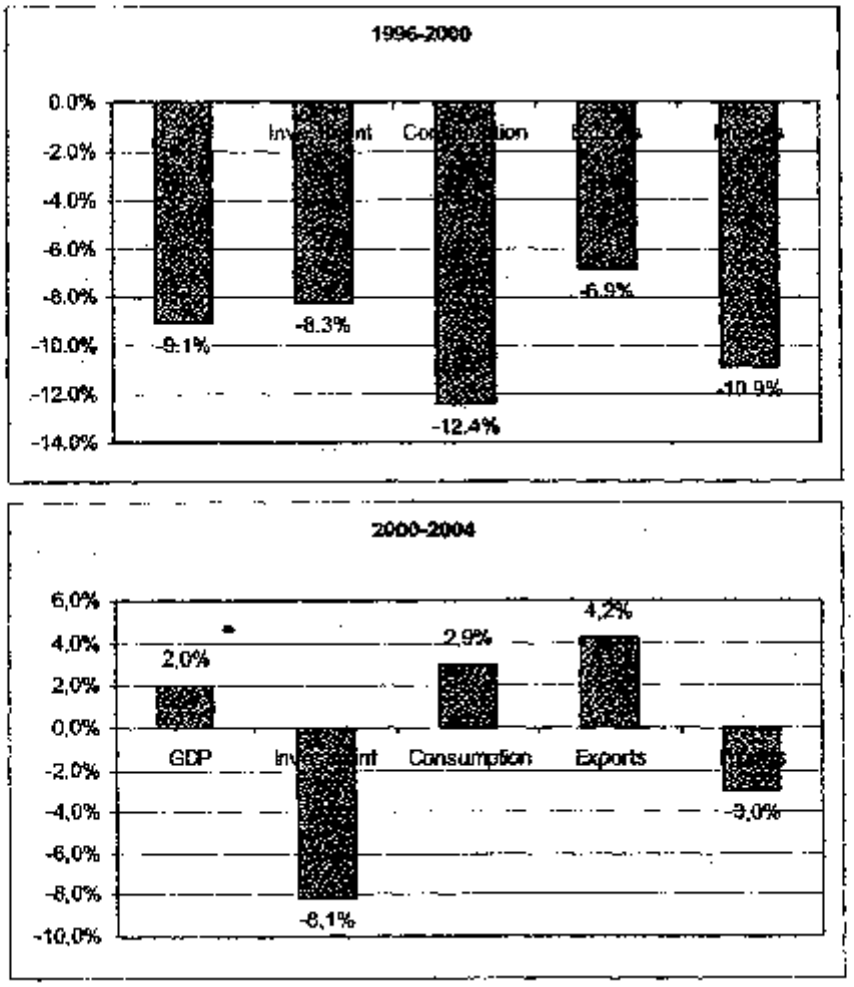
Figure A1 Development of Real GDP (2005 prices) in million NAF, 1996-2004



Source: Curalyse
2004 is an estimate

The decline in real GDP in the period 1996-2000 amounted to 9 percent. This decline is mainly attributed to a decrease in domestic demand caused by declining consumption (minus 12 percent) and investments (minus 8 percent). Changes in levels of import (minus 11 percent) and export (minus 7 percent) result in the fall in real GDP as well. After this decline the real GDP increased in the period 2000-2004 with 2 percent because of an increase in consumption and export of respectively 3 and 4 percent, and a decrease in import and investments of respectively 8 and 3 percent. Figure 2 presents an overview of the real differences between 1996 and 2000 level and 2000 and 2004 level for each of these macro-economic indicators.

Figure A2 Real difference between the 1996 and 2004 level for several macro-economic indicators

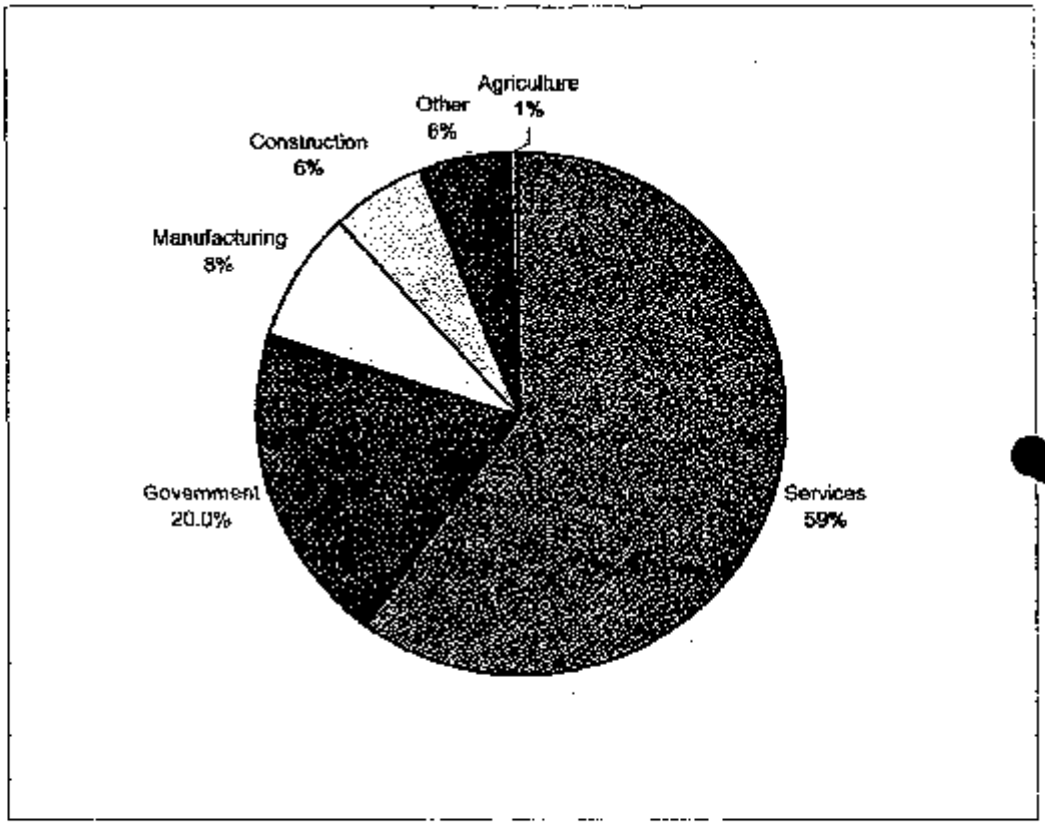


Source: Curalyse

A.1.3. Composition of GDP

A main characteristic of the Curaçao economic structure is the large share of the service sector in GDP (59 percent) i.e. financial services, tourism, logistics, trade- and the government sector (20 percent). Figure 2.3 presents an overview of the composition of Curaçao's GDP for the year 2000. No recent information is available.

Figure A3 Composition of GDP for Curaçao, 2000



Source: DEZ, Multi-Year Economic Programme

A.1.4. The service sector (including government)

Since Curaçao has only limited natural resources available and manufacturing goods are relatively expensive due to high transport costs, the service sector can considered to be Curaçao's natural pillar of the economy. Important services are tourism and financial and business services.

Tourism

Tourism is often quoted as the most important sector in Curaçao and an engine for growth for the economy as a whole. The number stay-over arrivals from Europe, North America and Canada registered an increase in 2003 compared to 2002. However tourism from South America and Caribbean declined.

International Financial Services

The international financial service sector (IFS) on Curaçao has been going through difficult times since the mid-90s. Because of international pressure against tax havens, the Antilles revised their tax regulations, which put an end to the difference between onshore and offshore. All companies are subject to a 34.5 percent profit tax rate. Before this revision the tax rate for offshore was about 3 percent. The IFS sector has been experiencing decreasing numbers in registered companies, tax income and operational

income. Despite this ongoing decline, the IFS sector is still an important sector for Curaçao.

Transportation (harbour logistics)

The harbour plays the most important role in the logistic sector of Curaçao. The harbour offers services as stevedoring, docking, tugboats, bunkering, ship repair etc. A major dredging company is developing Curaçao as its main port of operation for dredging activities in the region.

The government sector

In 2000 the contribution of the government sector to the Curaçao economy amounted to 18 percent. During the period 1996-2004 the Island Government's budget has shown a deficit except for year 2001. After a decline of the government's deficit during the period 1996-2001, the deficit increased to NAF 191 million in 2004. Table 1 provides an overview of the revenues and expenditures of the Island Government of Curaçao during the 1996-2004 period.

Table A1 Revenues and expenditures of the Island Government of Curaçao in NAF million (on cash-basis)

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Revenues	781	751	691	704	759	776	748	833	708
Expenditure	905	794	740	720	788	734	838	913	899
Government budget	-124	-43	-49	-16	-29	42	-90	-80	-191

Source: Curalyse

2004 figure is a projection made with the model Curalyse

A.1.5. The labour market

After a decrease of the population during the period 1996 to 2001, population increased to 130,400 inhabitants in 2004. Net emigration decreased from 5,500 persons in 1996 to zero in 2004. About 45 percent of the population is part of the labour force. The Curaçao labour market can be characterised by high unemployment, the unemployment rate amounted to 16.0 percent in 2004.

Table 2 presents an overview of the developments of the population size, net migration, labour force, number of unemployed and the unemployment rate during the period 1996-2004.

Table A2 Developments in the Curaçao labour market

	1996	1997	1998	1999	2000	2001	2002	2003	2004
Population (x 1,000)	146,3	145,1	141,3	136,7	131,3	126,8	129,9	133,6	130,4
Migration balance (immigration = -) x 1,000	5,5	6,4	5,6	5,6	6,6	5,1	2,0	0,0	0,0
Labour force (x 1,000)	66,1	61,1	61,2	56,3	54,0	53,2	53,8	57,7	58,8
Number of unemployed (x 1,000)	9,3	9,5	10,2	8,6	7,6	8,4	8,4	8,7	9,4
Unemployment rate (%)	14,1	15,5	16,7	15,3	14,0	15,8	15,6	15,1	16,0

Source: Curalyse

2004 figures are projections made with the model Curalyse

A.1.6. The Balance of Payments

Since the Balance of Payments (BoP) registers all economic transactions between residents of a country and non-residents, no separate BoP is compiled for the island Curaçao. As a result of its limited size, the Netherlands Antilles is a very open economy. For Curaçao and the Netherlands Antilles as a whole, a sufficient inflow of foreign exchange is an absolute must in order to be able to pay for the necessary imports.

The BoP presented in table 3 shows a deficit on the current account in 2001, because of the substantial deficit of the trade balance. This deficit is to a large extent balanced by a surplus on the service balance. In 2003 the BoP shows a surplus of NAF 211.8 million as a result of a lower deficit of the trade balance and a higher current transfer balance.

The capital account balance registered a small decrease in the period 2001 to 2003. The net financial account decreased from NAF 253.3 million in 2001 to a minus NAF 243.8 million in 2003.

Table A3 Balance of Payments Netherlands Antilles in NAF million, 2001-2003

	2001	2002	2003
Current account (1-4)	**-368.2**	**57.7**	**211.8**
1. Trade balance (goods)	-1994.5	-1838	-1767.6
2. Service balance	1579.8	1693.9	1554.3
* Transportation	120.7	122	116.2
* Travel	864.4	881.1	910.2
* Other services	594.8	690.7	527.9
3. Income balance	35.5	1.3	3.6
4. Current transfers balance	11	200.5	421.5
Capital account	**66.6**	**49.7**	**49.8**
Net financial account *	**253.6**	**-60**	**-243.8**
Change in reserves **	-451.1	-135.1	-98.4
Errors and omissions	48.0	-16.2	-16.9

*) Change in reserves is included in the net financial account

**) - sign indicates an increase

Source: Bank of the Netherlands Antilles

A.2 The Curaçao economy in the period 2005-2012

A.2.1 Economic policies

In January 2004 the implementation of Multi-Year Economic Programme 2004-2007 (MEP) started. At the moment, the MEP is Curaçao's most important economic policy document. The MEP is an attempt to structurally turn the economic tide. The overall objective of the program is sustainable economic growth.

To reach this objective the Inter-American Development Bank strategy is being followed. In this strategy economic policy is divided into four sub-policies or sub sectors:

A. Ensure long-term macroeconomic stability;
B. Create a stimulating enabling framework;
C. Stimulate a limited number of economic sectors to jump-start economic recovery;
D. Develop the necessary supporting policies.

The combination of these four pillars is expected to constitute a broad and sufficiently complete policy to attain the goal.

A. Ensure long-term macroeconomic stability
A balanced government budget, price stability (less than 2% inflation), a stable exchange rate and current account without structural deficits are the most important characteristics of the desired macroeconomic stability. In Curaçao especially government finances and the current account of the balance of payments are not on target-level yet. This has lead to increased taxation. The current account will be improved by stimulating tourism and other export activities. Subprograms B and C provide for this. In addition current price regulations will be examined.

B. Create a stimulating enabling framework
An enabling framework is defined as the whole of government policy, government behavior and economic structures that facilitates and stimulates the private sector to undertake economic activities. In the MEP three categories of policy are distinguished:
- Market-oriented policies: improving the working of the labor and the capital market and stimulating competition in general;
- Specific stimulating policy regarding innovation, export, trade and entrepreneurship;
- Policy regarding the government itself such as public sector efficiency, privatization and the tax system.

C. Stimulate a limited number of economic sectors
In subprogram C five sectors are selected to be stimulated in order to form the pillars of a diversified economic structure for Curaçao and to create a jump-start of economic activity. The main selection criteria are large current employment or expected employment growth and the ability to generate foreign currency. For Curaçao the following sectors are selected: tourism, logistics, e-commerce, international financial services (financial offshore) and oil-refinery. In the first three sectors the aim is substantial growth in each of these sectors while in the IFS and oil sector the aim is stabilizing these sectors.

D. Develop the necessary supporting policies
The economic program should be fine-tuned to those policies in other programs that have a large impact on the economic process or have important interfaces. The main other programs identified are educational, environmental and social programs.

A.2.2 Introduction economic growth paths

In order to assess the impact of the ISLA-refinery on the economy of Curaçao in the short, medium and long term, insight is needed in the economic development of Curaçao. In the light of the current economic developments as described in the previous section,

the following three growth paths have been chosen: a "trend" growth path, an "optimistic", and a "pessimistic" growth path. These three growth paths have been drafted for the period 2005-2012 in close co-operation with DEZ and mutually agreed upon, using their macro-economic model "Curalyse". Please refer to annex C for a brief description of Curalyse.

Trend growth path

In the trend growth path it is assumed that the Curaçao economy will continue along the path of the last years. Additional investments made in the context of the MEP and the restructuring of the investment climate as proposed are not included. The following assumptions are made:

- The migration balance is supposed to be 0 persons because of the expected economic growth in the period 2005-2012;
- In 2009 the government budget deficit will be decrease to a deficit of NAF 175 million;
- The tourism sector will increase with 5 percent yearly;
- The export excluding tourism remains stable because of declining revenues of the international service sector since the revised tax regulations for offshore companies;
- Investments by the government amount to NAF 23 million yearly between 2005 and 2012;
- The yearly investments by the private sector amount to NAF 40 million in the period 2006-2012.

Optimistic growth path

In the optimistic growth path it is assumed that about 75 percent of the projects part of the MEP is implemented in 2004increasing to 95 percent of the projects in 2012. 75 percent of these projects should be tourism projects. Out of development funds, NAF 25 million will be available for economic development on annual basis. In addition the island government will finance NAF 5 million yearly. The following additional assumptions are made:

- The migration balance decrease to -500 persons yearly. The last three years the emigration to the Netherlands decreased because of the better economic climate;
- Tourism will increase with 7 percent yearly. Experts expected a growth of 5 percent for 2005;
- The investments by the tourism sector amount to NAF 30 million in 2005 increasing to NAF 61.2 million in 2008. These investments concern hotel projects;
- The export excluding tourism remains will increase yearly with 1 percent because of agreements with countries like USA, Venezuela, Italy and Sweden;
- The labour productivity will increase with 25 percent in 2005 to 100 percent in 2008 because of the implementation of the IMF and OEDC recommendations in 2005.

Pessimistic growth path

In the pessimistic growth path the MEP and OECD policies will not be carried out and the government will not implement the proposed measures for improving the investment climate. As a result, the tourism sector will show a smaller growth compared to the trend growth path, hotel projects will not be implemented and the labour productivity will not improve. Private investments will decrease because of a lack of confidence in the government. The following assumptions are made.

- The migration balance is supposed to be 1,500 persons yearly. More persons will migrate to the Netherlands because of the bad economic developments;
- Tourism will increase with 1 percent yearly;
- The government investments amount to NAF 23 million in 2004 and decrease with 2 percent on annual basis. Due to less economic development, less investments will take place;
- The yearly investments by the private sector amount to NAF 15 million yearly compared to NAF 40 million in the trend growth path;
- The export excluding tourism decreases with 0.5 percent yearly during the period 2005-2008. The export remains stable from 2008 to 2012. It is assumed that before 2008, the offshore sector will not come to an agreement with countries resulting in a change in the negative trend.

Overview of growth paths and assumptions

Table 4 presents an overview of the assumptions and differences between the three growth paths.

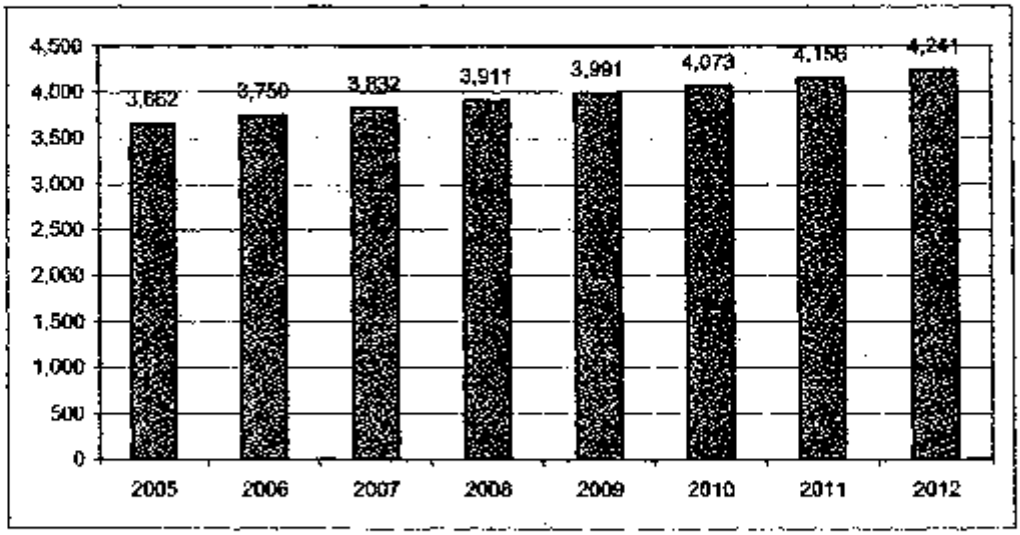
Table A4 Overview of assumptions growth paths

	Trend	Optimistic	Pessimistic
Migration balance (immigration = -) (persons yearly)	0	-500	1,500
Export excl. tourism (yearly growth)	0%	+1%	-0.5%
Tourism (yearly growth)	+5%	+7% (+5% 2005)	+ 1%
Investment government (yearly)	Yearly NAF 23 million	Yearly NAF 28 million	NAF 23 million in 2004 Yearly -2%
Investments companies (yearly)	Yearly NAF 40 million	2005: NAF 30.7 million 2006: NAF 41.3 million 2007: NAF 52.2 million 2008: NAF 61.2 million	Yearly NAF 15 million

A.2.3 Trend growth path for the period 2005-2012

In the trend growth path the GDP is expected to increase from NAF 3,662 million to NAF 4,241 million in the period 2005 to 2012.

Figure A4 Development in real GDP in NAF million (2005 prices), trend growth path 2005-2012



Source: Curalyse

The real GDP will increase with 15.8 percent. The developments of the macro-economic variable underlying the moderate annual GDP growth in the trend growth path are presented in table 5. The real GDP growth is mainly caused by an expected increase in consumption, investments, export and import of respectively 23.0, 18.5, 16.4, and 16.8 percent.

Table A5 Development macro-economic variables trend growth path: 2005-2012 (2005 figures in NAF million and 2005 prices and the remaining figures expressed in growth rates)

	2005	2006	2007	2008	2009	2010	2011	2012	Growth 2005-2012
Real GDP (2005 prices)	3,662	2.4%	2.2%	2.1%	2.0%	2.0%	2.0%	2.0%	15.8%
Real gross investment (2005 prices)	904	5.1%	2.7%	1.8%	1.8%	1.9%	1.9%	2.0%	18.5%
Total real consumption	2,403	3.1%	2.2%	2.2%	2.1%	2.1%	2.1%	2.0%	23.0%
Real export	2,838	2.9%	3.1%	3.1%	3.1%	3.0%	3.0%	2.9%	16.4%
Real import	2,916	2.9%	2.2%	2.0%	2.0%	2.0%	2.1%	2.1%	16.8%

Source: Curalyse

According to the trend growth path the population will increase from 131,800 to 142,300 people in the period 2005 to 2012. The migration balance will be 0 persons. The labour force is expected to be 45 percent of the population. The unemployment rate will slowly decrease from 17.5 percent in 2005 to 14.6 percent in 2012.

Table A6 Developments labour market trend growth path, 2005-2012

	2005	2006	2007	2008	2009	2010	2011	2012
Population (x 1,000)	131.8	133.3	134.8	136.2	137.7	139.3	140.8	142.3
Migration balance (immigration = -) x 1,000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Labour force (x 1,000)	59.0	59.9	60.6	61.4	62.2	63.0	63.7	64.5
Number of unemployed (x 1,000)	10.3	10.0	9.9	9.8	9.7	9.6	9.5	9.4
Unemployment rate (%)	17.5	16.8	16.3	15.9	15.6	15.2	14.9	14.6

Source: Curalyse

The development of the Government budget is presented in table 7. In the trend growth path the government will decrease the budget deficit from NAF 194 million in 2005 to NAF 159 million in 2012.

Table A7 Development government budget deficit (2005 prices, and NAF million)

	2005	2006	2007	2008	2009	2010	2011	2012
Revenues	724	749	774	799	822	847	873	900
Expenditure	918	936	957	977	997	1018	1038	1059
Deficit	-194	-186	-183	-179	-175	-171	-165	-159

Source: Curalyse

As presented in table 8, the foreign exchange reserves will increase in the trend growth path. The foreign exchange position will improve from NAF 1,689 million in 2005 to NAF 3,932 million in 2012. The current account (registering the balance of the trade in goods and services) improves from a surplus in 2005 of NAF 66 million to NAF 267 million in 2012.

Table A8 Development in the Balance of Payment (NAF million) of the Netherlands Antilles, 2005-2012

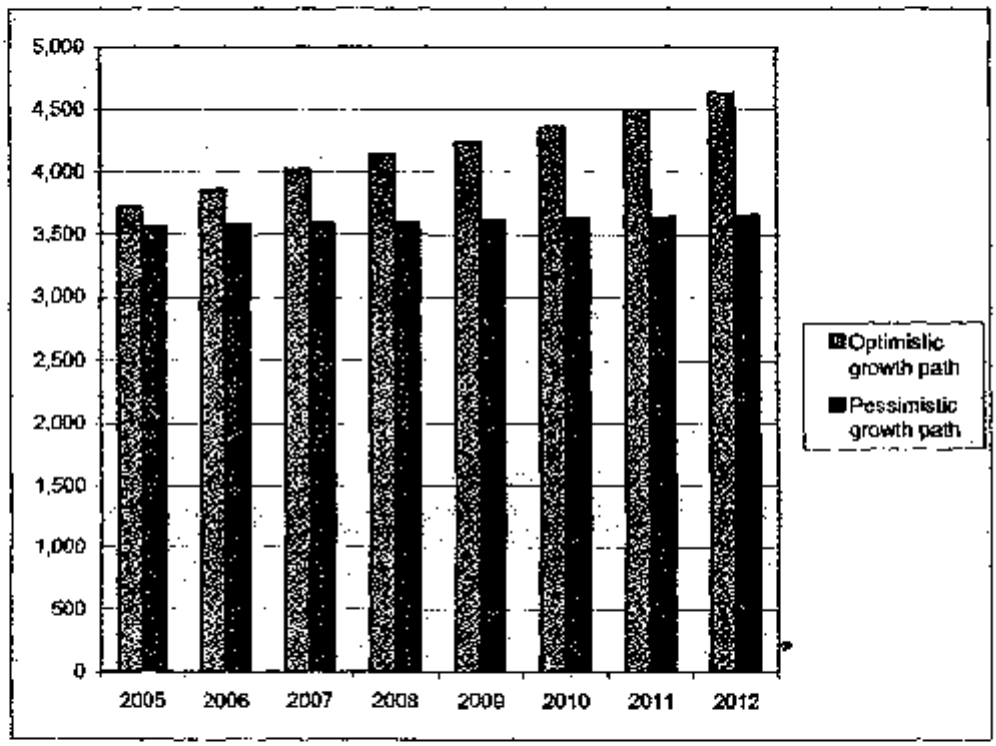
	2005	2006	2007	2008	2009	2010	2011	2012
Foreign exchange reserves	1,689	1,915	2,166	2,448	2,764	3,116	3,504	3,932
Surplus on current account	66	66	90	121	155	191	228	267

Source: Curalyse

A.2.4 Optimistic and pessimistic growth path for the period 2005-2012

Figure 5 presents the increase in real GDP for both the optimistic and pessimistic growth path. In the optimistic growth path GDP increases from NAF 3,719 million in 2005 to NAF 4,636 million in 2012. In the pessimistic growth path, GDP increases from NAF 3,569 million in 2005 to NAF 3,656 million in 2012.

Figure A5 Developments in real GDP (NAF million, 2005 prices), optimistic and pessimistic growth path, 2005-2012



Source: Curalyse

For all growth paths, the developments of the macro-economic variables underlying GDP growth are presented in table 9.

Table A3 Developments macro-economic variables for all three growth paths in NAF million (2005 prices), 2005-2012

		GDP	Investment	Consumption	Exports	Imports
Trend	value 2005	3,662	904	2,403	2,838	2,916
	growth 2005-2012	15.8%	18.5%	23.0%	16.4%	16.8%
Optimistic	value 2005	3,719	950	2,433	2,853	2,973
	growth 2005-2012	24.6%	26.3%	27.0%	34.7%	26.3%
Pessimistic	value 2005	3,569	853	2,343	2,779	2,838
	growth 2005-2012	2.5%	1.2%	-1.4%	8.5%	0.6%

In the optimistic growth path GDP growth between 2005 and 2012 is 24.6 percent. This growth figures are caused by increased investment (26.3 percent), increased consumption (27.0 percent) and increased exports and imports (34.7 and 26.3 respectively). In the pessimistic growth path GDP will only increase with 2.5 percent. This small growth is caused by an increase of exports (8.5 percent) and mitigated by an increase in investment and imports of respectively 1.2 percent and 0.6 percent and a decrease of consumption (minus 1.4 percent).

In the optimistic growth path labour force will improve significantly compared to the situation in 2005 with more than 13 percent, but in the pessimistic growth path it will hardly change. The unemployment rate in the optimistic growth path will decrease from 17.1 percent in 2005 to 12.4 percent in 2012. In the pessimistic growth path the unemployment will decrease from 17.9 to 16.1 percent. An overview of all labour market indicators under the three growth paths is presented in table 10.

Table A10 Developments labour market optimistic and pessimistic growth path, 2005-2012

Growth paths		2005	2006	2007	2008	2009	2010	2011	2012
Trend	Population (x 1,000)	131.8	133.3	134.8	136.2	137.7	139.3	140.8	142.3
	Migration balance								
	(immigration = -) x 1,000	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Labour force (x 1,000)	59.0	59.9	60.6	61.4	62.2	63.0	63.7	64.5
	Number of unemployed (x 1,000)	10.3	10.0	9.9	9.8	9.7	9.6	9.5	9.4
	Unemployment rate (%)	17.5	16.6	16.3	15.9	15.6	15.2	14.9	14.6
Optimistic	Population (x 1,000)	132.3	134.3	136.3	138.3	140.3	142.3	144.4	146.5
	Migration balance								
	(immigration = -) x 1,000	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50
	Labour force (x 1,000)	58.3	60.6	61.7	62.8	63.8	64.9	66.0	67.1
	Number of unemployed (x 1,000)	10.1	9.6	9.2	9.0	9.0	8.8	8.6	8.3
	Unemployment rate (%)	17.1	15.8	14.8	14.4	14.1	13.5	13.0	12.4
Pessimistic	Population (x 1,000)	130.3	130.3	130.2	130.1	130.1	130.0	129.9	129.9
	Migration balance								
	(immigration = -) x 1,000	1.50	1.50	1.50	1.50	1.50	1.50	1.50	1.50
	Labour force (x 1,000)	58.2	58.3	58.3	58.3	58.4	58.4	58.4	58.5
	Number of unemployed (x 1,000)	10.4	10.1	10.0	9.9	9.8	9.6	9.5	9.4
	Unemployment rate (%)	17.9	17.2	17.1	17.0	16.7	16.5	16.3	16.1

The development of the government budget is presented in table 11. The optimistic growth path shows a positive development. The deficit realized in 2004 (minus NAF 191 million) is replaced by a deficit of NAF 106 million in 2012. In the pessimistic growth path the deficit increased to NAF 251 million.

Table A11 Developments government budget, 2005-2012

Growth paths	2005	2006	2007	2008	2009	2010	2011	2012
Trend	-194	-186	-183	-179	-175	-171	-165	-159
Optimistic	-194	-179	-169	-157	-150	-137	-123	-106
Pessimistic	-204	-205	-212	-219	-225	-234	-242	-251

The development in the Balance of Payments of the Netherlands Antilles is presented in table 12 and table 13. In all growth paths total foreign exchange reserves and the balance of current account increase every year in the period between 2005 and 2012.

Table A12. Development in the foreign exchange reserves of (NAF million), 2005-2012

Growth paths	2005	2006	2007	2008	2009	2010	2011	2012
Trend	1,689	1,915	2,166	2,448	2,764	3,116	3,504	3,932
Optimistic	1,869	1,874	2,098	2,358	2,683	3,052	3,466	3,923
Pessimistic	1,707	1,959	2,244	2,568	2,915	3,306	3,737	4,213

Table A13 Surplus on current account of the Balance of Payments of the Netherlands Antilles (NAF million), 2005-2012

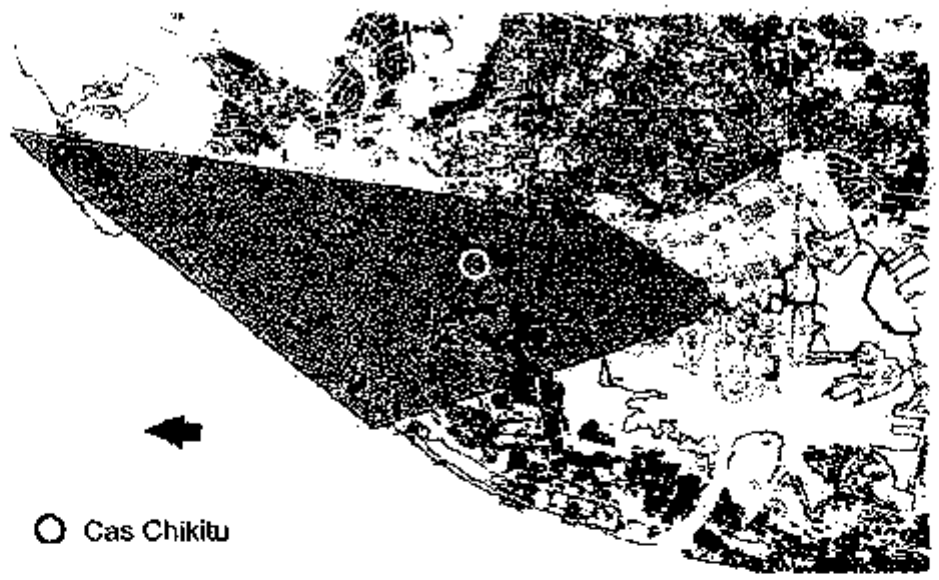
Growth paths	2005	2006	2007	2008	2009	2010	2011	2012
Trend	66	66	90	121	155	191	228	267
Optimistic	24	17	27	61	143	187	230	272
Pessimistic	84	91	125	164	187	228	271	315

Annex B Emissions and Health Impact

B.1 Introduction

The ISLA refinery, situated on the island of Curaçao, is surrounded by residential areas. As trade winds are dominating on the island east winds prevail. Air pollution, caused by the refinery, is therefore mainly restricted to the area downwind of Schottegat bay. The size of the area is approximately 2,100 ha and it has a residential population of about 16,700 inhabitants (some 12% of the total island population).

Figure B.1 Location of the refinery and polluted area downwind



The air pollution is caused by toxic pollutants, soot and odour nuisance, and residents living downwind of the refinery complain for many years about the hindrance and health effects they experience.

The strategic options for continuation of refinery activities near Schottegat will not completely remove this nuisance, although one may expect that the emissions will become more in line with the dedicated legislation than in the current situation (the base case).

The difference in level and duration of all unpleasant and harmful emissions between each strategic option and the base case should be considered as a welfare loss or a negative benefit, and must therefore be allowed for in the cost-benefit analysis. For a number of reasons this is not an easy task:

- An adequate and independent permanent emission measurement system for large combustion and process installations is currently lacking on Curaçao;
- The existing air quality (by type of pollution) in the various areas downwind of Schottegat is not systematically monitored;
- The contribution of various perpetrators to the pollution levels is not well known.
- The material and health damage impact, caused by different polluters in each residential area is difficult to estimate;
- The future annual refinery emissions for each of the strategic option can only roughly be estimated.

Nevertheless, we tried to quantify the most important emissions impacts, to be expected for each strategic case, and to estimate their present value. Doing this use was made of the limited available local emission information, which was supplemented with international impact data. Actually the attention was restricted to the *health effects of only two emission substances*: SO_2 and PM10. No attention was paid other emissions or to other effects, like material damage, endangerment of biodiversity, etc., neither to health or material damage effects of other pollutants.

B.2 Environmental policy

The legal framework for environmental control and monitoring of air quality, waste water and waste on Curaçao is the Nuisance Ordinance of 1994. It establishes compulsory environmental licenses for all industrial activities on the island. As a consequence and in compliance with the new legislation the ISLA refinery applied for an environmental licence in 1994. A temporary two-year licence was issued at first, after which, in 1997, a licence that should be revised every five years was issued.

Table B1 The air quality standards, specified in attachment F of the lease contract

Pollutant	Averaging Period	Ambient Air Quality Standard ($\mu g/m^3$)	Allowable Excursions
Sulphur oxides (as SO_2)	annual mean	80	None
	24 hour average	125	Three times per year
	24 hour average	365	Once per year
Particulate matter	24 hour average	150	5% of the total calendar days
	annual mean	75	None
Carbon monoxide	8 hour average	10,000	5% of the monitored periods
	1 hour average	40,000	5% of the monitored periods
Ozone	1 hour average	240	Once per year
Nitrogen dioxide	annual mean	100	None
Lead	maximum mean, averaged over a calendar quarter	1.5	None

The environmental relation between the ISLA refinery and the Island Government of Curaçao is provided for by attachment F of the lease contract. Attachment F of the contract specifies the applicable air quality standards and is listed in Table B.1. The standards are mainly based on the US clean air act of 1970.

The Government has recently reaffirmed its policy for the industry to comply with the Nuisance Ordinance of 1994. Furthermore the Environmental Service of Curaçao is considering tightening the air quality standards to a level comparable with the current standards in the USA and the EU.

B.3 Methodology used to assess environmental damage

The existing monitoring practice on Curaçao is not adequate to assess the total environmental damage, caused by the ISLA refinery. Therefore not all types of emissions can be taken into account and concentration levels and health effects must be estimated indirectly.

The damage prevented by closing the refinery or by choosing one of the strategic options instead of maintaining the status quo (base case) till 2019 has been estimated by taking the following steps.
First the total refinery emissions of SO_2 and PM10 were estimated for each option, by applying the so-called 'bubble concept'. This concept is employed for industrial complexes, using a variety of gaseous and liquid fuels to meet their energy needs, and emitting substances at different elevations. It reflects the introduction of a 'virtual *single* stack' for the whole industrial complex of ISLA (refinery plus utilities). The bubble approach results in an approximate estimation of total emissions to air of the complex. The inputs for the bubble approach are the following elements, their fuel consumption and their sulphur content.

Base case:
Refinery and utilities maintain current level and composition of fuel consumption:
- Residual fuel consumption in refinery furnaces: 436 t/d;
- Residual fuel consumption in utilities boilers: 1,091 t/d;
- Sulphur content of the residual fuel oil: 3.5% wt;
- FCCU coke combusted at FCCU regenerator: 400 t/d;
- Sulphur content of the coke: 3.5% wt;
- New diesel power plant: 144 t/d;
- Sulphur content of the residual fuel oil: 2.8% wt.

Case 1:
3 Flue gas scrubbers installed at 3 major refinery smoke stacks
- Residual fuel consumption in refinery furnaces: 592 t/d;
- Residual fuel consumption in utilities boilers: 1,091 t/d;
- Sulphur content of the residual fuel oil: 3.5% wt;

- 3 Flue gas scrubbers installed to clean the emissions from 419 t/d of refinery residual fuel consumption;
- FCCU coke combusted at FCCU regenerator: 400 t/d;
- Sulphur content of the coke: 0% wt, due to the installation of scrubbers;
- New diesel power plant: 144 t/d;
- Sulphur content of the residual fuel oil: 2.8% wt.

Case 4a:

Low sulphur residual fuel oil for the refinery furnaces

- Residual fuel consumption in refinery furnaces: 483 t/d;
- Sulphur content of the residual fuel oil: 0.2% wt;
- Residual fuel consumption in utilities boilers: 1,356 t/d;
- Sulphur content of the residual fuel oil: 3.0% wt;
- FCCU coke combusted at FCCU regenerator: 400 t/d;
- Sulphur content of the coke: 1.0% wt, due to full hydro-treatment of the FCCU feed;
- New diesel power plant: 144 t/d;
- Sulphur content of the residual fuel oil: 0.2% wt.

Case 5a:

Gasification unit providing clean syngas to refinery furnaces, and partially replacing the steam and power production from the utility plant

- All refinery furnaces will consume syngas (reducing residual fuel consumption to 0 t/d);
- Sulphur content of the syngas: 60 ppmw;
- Residual fuel consumption in utilities boilers: 826 t/d;
- Sulphur content of the residual fuel oil: 3.5% wt;
- FCCU coke combusted at FCCU regenerator: 400 t/d;
- Sulphur content of the coke: 3.5% wt;
- New diesel power plant: 144 t/d;
- Sulphur content of the residual fuel oil: 2.8% wt.

The next step consisted of estimating the ground level concentrations of SO_2 and PM10, and of determining which part is attributable to ISLA and which to other sources. Due to distance to the refinery (or to its single virtual stack), wind force and to differences in elevation, the concentrations will vary by area. It was not possible to estimate PM10-concentration levels for every area downwind of the refinery. Therefore, it was decided to restrict the attention to the Cas Chikitu area, which in the past appeared to be one of the most affected zones. In a former environmental analysis PM10-levels for refinery-emissions as well as the average PM10-concentration in the ambient air have been established for this area (see Tebodin/Tau-report, 2001). This relatively strongly affected area was considered representative with respect to PM10 as well as SO_2 concentrations for all areas affected.

Third, the concentrations calculated for Cas Chikitu were used to estimate adverse health effects on people, permanently exposed to SO_2 and PM10. This was done by using quantitative 'dose-response' estimates, based on and derived from a large number of international epidemiological analyses in different parts of world, and summarized in a

meta-analysis by the World Bank[14]. These estimates provide quantitative relationships between levels of SO_2 and PM10 concentrations and the incidence of specific types of mortality and illness for an average individual, exposed to these concentrations.
By applying these relationships to the estimated concentration levels for Cas Chikitu aggregate health effects were calculated for the total residential population downwind of Schottegat.
The last step consisted of calculating the direct costs inside the health care system (i.e. costs of activities of persons and/or institutions aimed at the delivery of care, such as prevention, diagnostics, therapy, revalidation and nursing) and indirect costs outside the health care system (i.e. costs resulting from production losses and replacement due to illness or death).

B.4 SO2 and PM10 emissions and ground level concentrations

From the information regarding fuel consumption and sulphur content for each case total SO_2, TSP and PM10 emission levels have been calculated[15]. The results are presented in Table B.2, column 2. The strategic options (case 1, 4a and 5a) lead, in comparison with de base case, to a substantial reduction of SO_2 emissions levels, and - to a lesser extent – to a reduction of PM10 emissions.

Table B2 Total ISLA emission levels, and Cas Chikitu ground level concentrations of SO_2 and PM10, calculated by RdK for each of the cases analysed

	ISLA emission levels	Cas Chikitu ground level concentration		
		all sources	ISLA sources	other sources
	t/d	$\mu g/m^3$	$\mu g/m^3$	$\mu g/m^3$
SO_2				
ground level concentration standard		80		
alternative cases:				
ISLA closed	0,0	44	0	44
Base case	143,0	117	93	24
Case 1	97,0	84	60	24
Case 4a	92,0	82	58	24
Case 5a	94,0	72	48	24
PM10				
ground level concentration standard		40		
alternative cases				
ISLA closed	0,0	38	0	38
Base case	3,3	90	52	38
Case 1	2,5	77	39	38
Case 4a	2,5	78	40	38
Case 5a	1,0	55	17	38

[14] Ostro Bart, *Estimating the health Effects of Air Pollutants – A Method with an Application to Jakarta*, Policy Research Working Paper 1301, The World Bank, Policy Research Department, Public Economics Division, May 1994.
[15] Environmental Impact Note, prepared by Selwyn J. Maduro.

Source: Environmental Impact Note, RdK (TSP-levels converted to PM10 concentrations)

The ground level concentration figures for Cas Chikitu were derived from the ISLA emission levels by using the procedure followed in the 2001 Tebodin/Tauw report, which makes a distinction between the contributions to the ambient air quality from the refinery and from other sources.
The Base Case emission levels represent the current operation. According to the figures presented SO_2 and PM10 ground concentration levels in the representative area exceed the existing standards.
Case 1 leads to an improvement in terms of emissions despite an increase in fuel consumption (from 436 to 592 t/d). Installation of three flue gas scrubbers leads however to a reduction of the sulphur content of emissions as well as to capturing of particulate matter at 90% efficiency. The expected ground level concentrations remain nevertheless higher than the standard.
In Case 4 the sulphur content of the residual fuel oil, used in the refinery furnaces, is assumed to be reduced from 3,5% to 0,2%, while the sulphur content of coke and fuel consumption by utility boilers also diminishes. With a total fuel consumption of 483 t/d used in the refinery furnaces, this implies a small further reduction of SO_2 emissions. The content of PM10 in this case is lower than in the base case because of the blending of low sulphur distillates in the residual fuel oil components. The ground level concentrations in the Cas Chikitu area of both types of emissions will not be different from the situation in Case 1.
In Case 5 the SO_2 emissions are approximately at the same level as in cases 1 and 4. However, the SO_2 produced in case 5 is dispersed at a higher elevation than in the former cases due to rationalization of the utility complex. The virtual stack height increases with some 20 meters, causing a significant decrease in SO_2 and PM10 concentrations in the ambient air of the representative residential area. In Case 5 the contribution of ISLA to the total concentration of PM10 in the area decreases to even less than one third (17 $\mu g/m^3$ on a total of 55 $\mu g/m^3$).

B.5 Health impact

The estimation of the health effects associated with changes in air pollution was based on a methodology developed by the World Bank and applied to Jakarta, Indonesia.[16] This estimation technique of health effects, which is in line with the methodology used by the U.S. Environmental Protection Agency (EPA) and is also applied in the study of the Environmental Service of Curaçao conducted by Tebodin-Tauw, uses dose-response functions that relate air pollution levels on various health outcomes. Three factors need to be determined: the dose response relationship; the susceptible populations and the relevant change in air pollution.

Available epidemiological studies relate concentrations of ambient particulate matter and SO_2 to adverse health outcomes, including mortality, respiratory hospital admissions,

[16] Ostro Bart, *Estimating the Health Effects of Air Pollutants – A Method with an Application to Jakarta*, Policy Research Working Paper 1301, The World Bank, Policy Research Department, Public Economics Division, May 1994.

emergency room visits, restricted activity days for adults, respiratory illness for children, asthma attacks and chronic disease. The Jakarta case study of the World Bank combined a large number of such studies in a meta-analysis.

The study uses dose-response functions estimated in a number of developed countries and although it makes some adaptations for the local situation, it is, therefore, implicitly assumed that the relationships[17] between the levels of air pollution and subsequent health effects can be extrapolated to estimate and predict health effects in Curaçao. There is still a great deal of uncertainty and controversy about much of the research on which these estimates are based. Recognizing this uncertainty, the World Bank study provides three estimation results: a central estimate and upper and lower bound estimates to indicate the ranges within which the actual health effects are likely to fall. In Table B.3 the high estimates are presented for the health impacts documented in the study.

In addition, the impact categories presented in this paper are not all-inclusive, since quantitative evidence is not available for every health effect suspected of being associated with air pollution. Also, air pollution has been associated with non-health effects, including materials damage, soiling, vegetation losses and visibility degradation. These types of omissions suggest that the results of this analysis are likely to underestimate the health effects, and will certainly underestimate the total effects, resulting from air pollution.

Table B3 Health improvements for the population living downwind of Schottegat after transition to the options mentioned (calculations based on high estimation of dose response relationships used)

sub-stance	type of health effect	health effect (high estimation) related to total residential population of downwind Schottegat area			
		premature closure	case 1	case 4	case 5
SO_2	***premature mortality (#/yr)***	?? - 10	- 5	- 5	- 6
	cough in children (#/yr)	- 11	- 5	- 5	- 7
	chest discomfort in adults (#/yr)	-12 100	-5 470	-5 800	-7 460
PM10	***premature mortality (#/yr)***	?? - 8	- 2	- 2	- 5
	respiratory symptoms (# days/yr)	-23 860	-5 960	-5 510	-16 060
	respiratory hospital admissions (#/yr)	- 14	- 3	- 3	- 9
	asthma attacks (#/yr)	-1 810	- 450	- 420	-1 220
	chronic bronchitis (#/yr)	- 8	- 2	- 2	- 5
	emergency room visits (#/jr)	- 30	- 7	- 7	- 20
	lower respiratory illness in children (#/yr)	- 70	- 18	- 16	- 47
	restricted activity days (# days/yr)	-7 860	-1 970	-1 810	-5 290

The mortality and health impacts presented in Table B.3 are calculated by using the differences in ground level concentrations estimated for each strategic option (plus the

[17] The general expression for the dose-response functions used is $dH_i = b_i * POP_i * dA$, where:
- dH_i : change in population risk of health effect I ('response')
- b_i : reaction or response coefficient
- POP_i : population at risk of health effect I
- dA : change in ground level concentration of the pollutant under consideration

premature closure case) and the base case situation as an indicator for the representative toxic dose (the difference for the Cas Chikitu area), administered to an average member of the residential population living downwind of Schottegat. In case a dose leads to a pollution level below the policy standard the dose-response relationship was supposed to remain valid[18].

B.6 Economic value of health impacts

Based on dose-response relationships for SO_2 and PM10 several health and health care effects have been estimated (see Table B.3). For SO_2 the following health effects were established: mortality; cough in children; and chest discomfort. For PM10, the health (care) effects calculated are: mortality, asthma attacks; chronic bronchitis; emergency room visits (ERV); lower respiratory illness in children; restricted activity days; respiratory symptoms and respiratory hospital admissions (RHA).
However, not all estimated health effects presented in Table B.3 could be expressed in monetary values. The effects for which such values were established are mentioned in bold and cursive letters.
By estimating a monetary value of the health effects a distinction was made between three categories: direct costs, or the costs of activities of persons and institutions aimed at the delivery of care (prevention, diagnostics, therapy, revalidation, nursing, etc.); indirect costs, resulting from production losses and replacement due to illness, and costs of mortality (based on estimates of the value of preventing a fatality). The benefits of each strategic refinery option are the calculated savings of these three types of costs.

B.6.1 Direct costs saved

The following three categories are counted as direct costs. The unit costs for these health effects were derived in a former study, commissioned by RdK and carried out by ECORYS (2001). The cost items mentioned here are expressed in 2001 prices. Before presenting aggregate cost figures, the unit costs were raised to the expected 2005 price level by applying the appropriate inflation index.

The decrease in *Emergency Room Visits*
According to information provided by the St. Elisabeth Hospital in Willemstad, the direct cost of such a visit including necessary medication was in 2001 NAF 250.

Reductions in *Respiratory Hospital Admissions*

[18] There is a presumption by some that a threshold exists at the EPA air quality standard, or at the WHO ambient guidelines for criteria pollutants. Most of the studies reported here have estimated linear or log-linear functions suggesting a continuum of effects down to the lowest levels, and have not specifically identified a threshold level. When efforts have been made to identify a threshold, little conclusive evidence has been found that one exists. In fact, many recent epidemiological studies report an association between air pollution and health at ambient concentrations at or below the current federal standard. The former Administrator of the EPA has stated, "In a heterogeneous population it is unlikely that, for any pollutant, there will be a single scientifically defensible threshold applicable to all people. Instead, there will be a series of thresholds for different sensitive populations and a threshold of zero for some people". For this report we calculate the effects of bringing pollution down according to the World Bank dose-response relationships, irrespective of the question if the new level of pollution lies above or below the existing policy standards.

The unit costs of a Respiratory Hospital Admission are calculated taking into account the Average Length Of Stay (ALOS) for each Respiratory Hospital Admission and the cost of staying in the hospital per day.
The Average Length of Stay resulting from an admission to the hospital due to respiratory disorders is very much dependent upon the procedures and efficiency of an individual hospital. No specific data on the Average Length of Stay were found for Curaçao hospitals. The World Bank study on Indonesia calculates the Average Length of Stay at 10.13 days. Information from several American studies refers to an Average Length of Stay of 5 to 6 days. Therefore, in the estimate of the cost of Respiratory Hospital Admission both a low and a high unit cost variant will be presented.
According to the St. Elisabeth hospital in Willemstad, the cost per day of staying in their hospital (based on third class) was NAF 296. However, this cost per day excluded the cost of additional investigations and treatment. No reliable data on these costs were available, but a conservative estimate suggests that these could be well over NAF 100 per hospital day. In the calculations, two variants were used in which the low estimate only takes the cost of a hospital day into account, whereas in the high estimate additional cost for treatment is added.
Combining the variations in Average Length of Stay, cost per hospital day and the estimates for the number of Respiratory Hospital Admissions a low and high Unit cost variant result. In the low estimate, a Respiratory Hospital Admission costed NAF 1,776 annually. In the high estimate, a Respiratory Hospital Admissions was calculated at NAF 4,011 per annum.

Asthma attacks
No information on the unit cost of asthma attacks was available for Curaçao. However, based on cost of asthma studies in the USA and the United Kingdom, an estimate of the direct cost of asthma attacks could be calculated.
The cost of an asthma study by the American Asthma and Allergy Foundation estimated the total direct cost of asthma in the USA at US$ 6.1 billion per annum.[19] Per asthma patient the direct cost amount to US$ 431 per annum. The two largest cost drivers in the treatment of asthma are inpatient hospital care and medications.
Another study on the United Kingdom puts the total direct cost of asthma per patient at an average of GBP 167 per annum (about US$ 250).[20] The study makes a further distinction between cost per patient experiencing an asthma attack and those who did not. Patients suffering an asthma attack incurred on average a much higher cost (GBP 381 or NAF 950 in 2001) than those who did not (GBP 108 or NAF 270).
Because the UK study specifies the direct cost of asthma attacks rather than the cost of asthma these estimates have been taken into account here. The UK figures have been adjusted to reflect costs estimated separately such as hospital admissions and emergency room visits. In addition, price differences between UK and Curaçao were cancelled out by using a crude deflator based on the ratio of GDP at Purchasing Power Parity of the two countries. The cost of medications is assumed to be equal. The direct cost per asthma attack in Curaçao was estimated at NAF 285.

[19] Asthma and Allergy Foundation of America, *Cost of Asthma*, Washington, 2000.
[20] Hoskins, G. e.a., *Risk Factors and costs associated with an asthma attack*, Thorax 2000;55:19-24.

The estimate presented is of course very rough and should be treated with caution. Reflecting this, two scenarios are presented for the direct cost of asthma attacks in which the low estimate takes only 75 percent of the cost calculated into account (or NAF 214), whereas the high estimate assumes the maximum cost to be 125 percent (or NAF 356).

B.6.2 Indirect costs saved

Indirect cost estimates outside the health care system are captured in the established relationship between air pollution and *Restricted Activity Days*. These are defined as days spent in bed, days missed from work and other days when normal activities are restricted due to illness, even if medical attention is not required.
The economic value of Restricted Activity Days is determined by estimating the production losses associated with it (in 2001). To this extent the number of days resulting in lost working days was established versus the number of days lost as non-working days (elderly people, unemployed, leisure days). The World Bank assumes in its Indonesia study that only 20 percent of the Restricted Activity Days are lost as working days. Based on information on unemployment in the downwind area in Curaçao, a higher percentage viz. 35.5 percent, of working days within Restricted Activity Days is calculated (used as base for the high unit cost estimation). This figure is used as an alternative for the 20 percent used in the World Bank study (used for estimating low unit cost).
The production losses associated with a Restricted Activity Day as a working day are estimated at an area-specific average 2001 monthly gross salary of NAF 1,773 or NAF 81 per working day. Restricted Activity Days that are not working days, are – in line with the World Bank - valued at one third of the value of a working day (NAF 26.8).
As a result the 2001 high unit cost per RAD was estimated at NAF 46 and the low unit cost at NAF 38.

The calculation of Respiratory Hospital Admission in the previous section only took into account the direct cost of staying in the hospital, whereas the calculation of Restricted Activity Days is limited to those days in which no medical attention is sought. Therefore, the production losses of the days spent in hospital have been calculated separately as well.

B.6.3 Costs of mortality saved

The effects of reducing air pollution to norm levels have been related to mortality in the downwind area. Trying to estimate the economic value of deaths avoided is a difficult issue. Often such an exercise is not carried out because of ethical reasons. On the other hand society values people's lives implicitly. For instance the actual level of security in traffic is based on considerations of the cost of mitigating measures and acceptable risk levels for people participating in traffic. Implicitly, the value of deaths avoided as a result of traffic accidents is then determined, but most people do not wish to present the argument explicitly.

Table B4 *Official EU values of prevented fatalities*

Country	Fatality costs * € 1,000

	(2004 values)
Finland	1,934
France	1,500
Germany	1,257
Netherlands	1,741
Norway	3,016
Sweden	1,954
Switzerland	1,912
UK	2,107

A recent international study[21], commissioned by the European Commission presented the current official values for the prevention of fatalities in traffic accidents. Table B.4 presents some results. The table shows considerable differences in the valuation of avoided mortality. Here the figure for the Netherlands has been used as a base. This value has been adapted to the Curaçao situation by taking the ratio of Curaçao GDP (at PPP) and Dutch GDP (at PPP). The result of NAF 1,17 million per life lost was considered as a high unit cost estimate. In addition to this a low unit cost figure has been used with half the size of the high estimate.

B.6.4 Unestimated costs

It was mentioned earlier that the economic *implications* could not be estimated for several health effects. These are children's cough, chronic bronchitis, lower respiratory infections and chest discomfort. This is not to say that no direct or other indirect cost is associated with these disorders. Within the scope of the study and the absence of detailed reliable information no reliable cost estimates could be presented for these disorders. However, indirect costs associated with these diseases like Restricted Activity Days and mortality, and direct costs like Respiratory Hospital Admission and Emergency Room Visits are captured in this analysis.

Another aspect not taken into account is the loss in the quality of life that may accompany the health effects identified, like an asthmatic child not being able to engage in sports or other activities. Clearly, these are 'costs' in the real sense of the word, but because of their subjective nature they can not be assessed quantitatively.

B.7 Overview of health benefits

The analysis carried out in the previous sections is summarised in table B.5 below. It shows the range within which the economic benefits from avoided health effects are estimated. The low-low scenario combines the lowest estimate of the health effects with the lower unit cost estimates. Alternatively, the high-high variant presents the highest estimate for the health effects with the higher unit cost calculations.

[21] EU Rosebud Project, *The use of efficiency assessment tools*, p. 29, Brussels June 2004

Table B5 Total annual health costs prevented per case (compared with total annual health costs in the base case, caused by ISLA emissions)

estimation of health effect	cost estimation:	health costs related to total residential population downwind Schottegat area (× mln NAF; 2005 pri			
		premature closure	case 1	case 4	ca
low damage estimation	high	-7,4	-2,3	-2,3	
central damage estimation	high	-13,2	-4,4	-4,3	
high damage estimation	***high***	***-24,6***	***-8,8***	***-9,0***	
		0,0	0,0	0,0	
low damage estimation	low	-3,8	-1,2	-1,1	
central damage estimation	low	-6,7	-2,2	-2,2	
high damage estimation	low	-12,5	-4,5	-4,5	

Annex C Application of the Curalyse model

Model

Curalyse is a macro-economic model developed for the island economy of Curaçao. This instrument consists of a database, inclusive of all economic data currently available (e.g. National accounts, Government Financial Statistics, Monetary Survey, Prices and Labour Market Survey), and a simulation and forecasting model. Curalyse was built during 1995 and 1996 by the Department of Economic Affairs (DEZ) in close co-operation with Micromacro Consultants and has been operational since 1996.

Curalyse has been used intensively to make several policy simulation runs, scenarios and forecasts, with a view to advising the Government on matters of major policy. This instrument is used e.g. to:

- Monitor the socio-economic development of the island economy of Curaçao;
- Calculate the effects of structural measures proposed by the IMF and IDB;
- Show the impact of policy measures on the main export sectors of the Curaçao economy (tourism, financial off-shore, and oil refinery);
- Make consistent forecasts for the annual Economic Outlook of the Department of Economic Affairs of Curaçao;
- Provide a consistent quantitative framework for discussions in workshops held twice a year with, among others, economists of the Central Bureau of Statistics, Central Bank, Department of Finance, Trade Unions, and Chamber of Commerce.

Since its creation, Curalyse has been regularly updated and enhanced in order to better reflect the functioning of the island economy and to project more accurately the variations/changes introduced in the local economy. The Department of Economic Affairs, DEZ, has made this model publicly available and has promoted and stimulated its wide usage for business and academic purposes by holding periodic awareness/training workshops following the release of each new version throughout the year.

Curalyse and this study

In this study, Curalyse has been used to calculate the direct and indirect effects of the selected alternatives (base case, premature closure, case 1, case 4a and case 5a) in terms of value added (VA), as one of the components in the CBA. The following data has been used as input for Curalyse (only as far as it concerns local expenditures):

- Investment costs, needed to realize cases 1, 4a and 5a;
- Costs of removing the installations after closing the refinery, and of site cleaning;
- Operation costs;
- Annual shutdowns;
- Investment oil depot.

As two of the strategic options (case 4a and 5a) span an estimated production period running till 2032, after which a ten year removal and cleaning period is assumed to take place, all calculations run till the year 2042. However, Curalyse is a model for short run developments. For this study DEZ developed Curalyse to a medium run model with economic data for the period 1996-2012. The effects after 2012 are considered (more or less) constant.
DEZ also drafted three growth paths for the period 2005-2012; a trend growth path, an optimistic and pessimistic growth path. For an overview of the assumptions and differences between the three growth paths refer to section 4.2 or Annex A.

In close consultation and cooperation with DEZ the method used to calculate the various effects mentioned above has been discussed and agreed upon in the period March-end of June 2005. The following equations in the Curalyse model have been used for relevant inputs:
For investments (and also for shutdowns)

- Row 13 (gross investments by companies) and;
- Row 59 (balance of payments);

For operations expenditures:

- Row 13 and 59 (see investments) for payments to contractors on the island;
- Row 18 (export);
- Row 93 employment) and;
- Row 133 (available income).

For row 13 is assumed that 85% of the ISLA wages are available income, of which 70% is assumed to be spent in the economy!

- Row 18 for other expenditures, not mentioned before (like medical services, port activities, etc.);
- Row 18 for expenditures in BOO.

It is assumed that 90% of all expenditures are not affecting the local economy of the island but directly go to the bank account of foreign shareholders.

- Row 13 for the lease fee received by RdK.

Only the operational part of the lease fee is used to calculate effects on the local economy. The remaining part being used later on for new investments (see case 1, case 4a and 5a) is set aside and will be only effective when new investments are planned and agreed upon. This is done to avoid double counting.

For removal and site cleaning activities:

- Row 13 (gross investments companies).

All direct and indirect effects have been calculated firstly in terms of Gross Value Added at current prices) and in the end translated into 2005-prices (used in the CBA model) and in terms of employment (unemployment).
These effects are based on the trend growth paths for the mid term, because calculating the contribution of ISLA is not depending on the development of the local island economy, but on the world market developments of demand and supply.

In case the refinery is closed down, we have used an optimistic and pessimistic growth path, dealing with the possibility of solving (or not) the problem of unemployment (see chapter 4.4 and see later on in this annex).

Results of effect calculation Curalyse

The above mentioned cost effects are used as input in Curalyse. These inputs changed the value added of companies in Curacao. The difference in value added is one of the components in the CBA. The following table shows the results of the VA-effect calculation.

Table C1 Results of VA-effect calculation with Curalyse (in million NAF, in constant 2005 prices)

Value Added effects (NAF mln)	base case	premature closure	case 1	case 4a	case 5a
Investment	-	-	2007: 24 2008: 41	2009: 12 2010: 33 2011: 39	2009: 14 2010: 38 2011: 44
Removal/cleaning	2019-2028: 49 yearly	2010-2019: 49 yearly	2019-2028: 49 yearly	2032-2041: 49 yearly	2032-2041: 49 yearly
Operations (excluding lease fee RdK)	2007: 177 decreasing to 171 in 2018	2007: 177 2008: 176 2009: 175	2007: 177 2008: 176 2009: 163 decreasing to 160 in 2018	2007: 177 decreasing to 160 in 2011 2012: 222 decreasing to 220 in 2031	2007: 177 decreasing to 160 in 2011 2012: 213 decreasing to 212 in 2031
Lease fee RdK	2007-2014: 4 2015-2018: 5	2007-2009: 4	2007-2014: 4 2015-2018: 5	2007-2014: 4 2015-2031: 5	2007-2014: 4 2015-2031: 5
Annual shutdowns (cycle of 4 years to be repeated during whole period of operation)	2007-2018 Year 1: 12 Year 2: 14 Year 3: 21 Year 4: 27	2007: 12 2008: 14 2009: 21	2007-2018 Year 1: 13 Year 2: 15 Year 3: 23 Year 4: 29	2007-2031 Year 1: 18 Year 2: 20 Year 3: 30 Year 4: 38	2007-2031 Year 1: 19 Year 2: 22 Year 3: 33 Year 4: 41
Investment oil depot	2019: 9.5 2020: 5.1	2010: 9.5 2011: 5.1	2019: 9.5 2020: 5.1	2032: 9.5 2033: 5.1	2032: 9.5 2033: 5.1

The annual effects have been weighted with a discount rate. For the net present value (NPV) of the effects refer to annex D.

Closure of the refinery and re-employment of workers

It is assumed that in case of closure of the refinery the following will happen:

Firstly:

- From ISLA personnel, people with university degrees are leaving the island looking for jobs abroad, and also 10 percent of the people older that 60 years old will retire;
- From contractors personnel and other indirect related activities, it is also assumed that 10 percent of the people will retire.

Secondly:

Because of removal and site cleaning activities, to be planned to start immediately after closing down the refinery, it is assumed that about 200 people from local contractors will be employed in these kinds of activities.

Thirdly:

The remaining part of the workers from ISLA, local contractors and other indirect related activities will be re-employed within 2 years:

- For 75 percent in the optimistic growth path (in which the economy is able to absorb a significant part of people getting unemployed in case of closure of the refinery;
- For only 25 percent in the pessimistic growth path (in which the economy is not able to realize re-employment in a significant way).

All new jobs are valued at an annual average salary earned in Curaçao (calculated at NAF 33,817 in 2005 prices), increased with 20 percent for valuing average wages in service sector and increased thereafter with 35 percent in order to value the related consumption effects (resulting in annual VA of about NAF 55,000).

Costs for ISLA only once to be paid for their unemployed workers are estimated at a one year gross salary on average. For contractors and other related indirect activities a cessantia will be paid to unemployed people estimated at 25 percent of an annual salary on average.

Annex D Main results of the CBA

- Table 1 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%;
- Table 2 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%;
- Table 3 Optimistic growth path, central health costs estimation, share RdK in investments (case 4a + 5a) is 10%;
- Table 4 Pessimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 10%;
- Table 5 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 20%;
- Table 6 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 20%;
- Table 7 Optimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 20%;
- Table 8 Pessimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 20%;
- Table 9 Sale to PDVSA, Optimistic growth path, high health costs estimation;
- Table 10 Sale to PDVSA, Pessimistic growth path, high health costs estimation;
- Table 11 Sale to PDVSA, Optimistic growth path, medium health costs estimation;
- Table 12 Sale to PDVSA, pessimistic growth path, medium health costs estimation;
- Table 13 Sale to third party, optimistic growth path, high health costs estimation;
- Table 14 Sale to third party, pessimistic growth path, high health costs estimation;
- Table 15 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs + 20%;
- Table 16 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs + 20%;
- Table 17 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs - 20%;
- Table 18 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs - 20%;
- Table 19 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: no cleaning costs only demolition costs;
- Table 20 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: no cleaning costs only demolition costs;
- Table 21 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: cleaning costs + 300%, no change in demolition costs;

- Table 22 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: cleaning costs + 300%, no change in demolition costs.

Table 1 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%.

		Premature closure - Base case	Case 1 - Base case	Case 4a + Base case	Case 5a + Base case		Base case
Island of Curaçao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	8	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-157		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-378	119	587	564		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	37	10		352
	Balance mln NAF (NPV)	-475	46	550	554		1311
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2827
	Total revenues	-1565	82	2557	2377		2827
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1060		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance mln NAF (NPV)	-259	-432	251	-164		469

Table 7 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%.

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Island of Curacao	**Revenues mln NAF (NPV)**					
	VA ISLA + contractors operation	-751	40	646	600	1189
	VA contractors investments	0	56	56	64	0
	VA contractors removal/cleaning	130	0	-68	-68	96
	VA oil depot	6	0	-3	-3	4
	VA shutdown	-84	8	109	127	123
	VA RdK (lease)	-19	0	11	11	29
	Employment effects (personnel benefits)	144	6	-68	-70	96
	Value increase ISLA site	0	0	0	0	0
	Sale of ISLA to foreigner	0	0	0	0	0
	Total revenues	-575	110	683	661	1537
	Costs mln NAF (NPV)					
	Investment costs RdK	0	118	140	158	0
	Investment public infrastructure	0	0	0	0	0
	Investment oil depot	8	0	-4	-4	6
	Removal/cleaning costs	190	0	-100	-100	140
	Employment effects (costs contractors)	5	0	4	4	4
	Health costs	-107	-45	-3	-49	203
	Total costs	97	73	37	10	352
	Balance mln NAF (NPV)	-671	38	645	651	1185
Operator of ISLA	**Revenues mln NAF (NPV)**					
	Gross margin	-1565	82	2557	2377	2627
	Total revenues	-1565	82	2557	2377	2627
	Costs mln NAF (NPV)					
	Operational costs	-1216	153	1006	1080	1922
	Lease	-130	0	56	56	206
	Purchase of ISLA	0	0	0	0	0
	Investment costs ISLA	0	359	1257	1420	0
	Cessantia	40	2	-13	-14	30
	Total costs	-1306	514	2306	2540	2157
	Balance mln NAF (NPV)	-259	-432	251	-164	469

Table 3 Optimistic growth path, central health costs estimation; share RdK in investments (case 4a + 5a) is 10%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	***Revenues mln NAF (NPV)***						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-94	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-378	119	587	564		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-57	-22	1	-27		104
	Total costs	146	96	42	32		253
	Balance mln NAF (NPV)	-524	23	546	532		1410
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance mln NAF (NPV)	-259	-432	251	-164		469

Table 4 Pessimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 10%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Island of Curacao	**Revenues mln NAF (NPV)**					
	VA ISLA + contractors operation	-751	40	646	600	1189
	VA contractors investments	0	56	56	64	0
	VA contractors removal/cleaning	130	0	-68	-68	96
	VA oil depot	6	0	-3	-3	4
	VA shutdown	-84	8	109	127	123
	VA RdK (lease)	-19	0	11	11	29
	Employment effects (personnel benefits)	144	6	-68	-70	96
	Value increase ISLA site	0	0	0	0	0
	Sale of ISLA to foreigner	0	0	0	0	0
	Total revenues	-575	110	683	661	1537
	Costs mln NAF (NPV)					
	Investment costs RdK	0	118	140	158	0
	Investment public infrastructure	0	0	0	0	0
	Investment oil depot	8	0	-4	-4	6
	Removal/cleaning costs	190	0	-100	-100	140
	Employment effects (costs contractors)	5	0	4	4	4
	Health costs	-57	-22	1	-27	104
	Total costs	148	96	42	32	253
	Balance mln NAF (NPV)	-721	15	641	629	1284
Operator of ISLA	**Revenues mln NAF (NPV)**					
	Gross margin	-1565	82	2557	2377	2627
	Total revenues	-1565	82	2557	2377	2627
	Costs mln NAF (NPV)					
	Operational costs	-1216	153	1008	1080	1922
	Lease	-130	0	56	56	206
	Purchase of ISLA	0	0	0	0	0
	Investment costs ISLA	0	359	1257	1420	0
	Cessantia	40	2	-13	-14	30
	Total costs	-1306	514	2306	2540	2157
	Balance mln NAF (NPV)	-259	-432	251	-164	469

Table 5 Optimistic growth path, high health costs estimation; share RdK in investments (case 4a + 5a) is 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	648	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-378	119	587	564		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	279	315		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	177	169		352
	Balance mln NAF (NPV)	-475	46	410	396		1311
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2567	2377		2627
	Total revenues	-1565	82	2567	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1118	1262		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2167	2383		2157
	Balance mln NAF (NPV)	-259	-432	391	-6		469

Table 6 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-575	110	683	661		1537
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	279	315		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	6	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	177	168		352
	Balance mln NAF (NPV)	-671	38	506	493		1185
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1118	1262		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2167	2383		2157
	Balance mln NAF (NPV)	-259	-432	391	-6		469

Table 7 Optimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	48	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	5	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-378	119	587	564		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	278	315		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-57	-22	1	-27		104
	Total costs	146	96	181	190		253
	Balance mln NAF (NPV)	-524	23	406	375		1410
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	55		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1118	1262		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2167	2383		2157
	Balance mln NAF (NPV)	-259	-432	391	-6		469

Table 8 Pessimistic growth path, medium health costs estimation, share RdK in investments (case 4a + 5a) is 20%

		Premature closure - Base case	Case 4 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curaçao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/clearing	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-575	-110	683	661		1537
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	279	315		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	6	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-57	-22	1	-27		104
	Total costs	146	96	181	190		253
	Balance mln NAF (NPV)	-721	15	501	471		1284
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	58		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1118	1262		0
	Cessantia	40	2	-13	-14		38
	Total costs	-1306	514	2167	2383		2157
	Balance mln NAF (NPV)	-259	-432	391	-6		469

Table 9 Sale to PDVSA, Optimistic growth path; high health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	682	636		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/clearing	130	0	-66	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	-25	-25		29
	Employment effects (personnel benefits)	340	15	-163	-157		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	430	430		0
	Total revenues	-378	119	1017	994		1863
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	0	0		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	-103	-148		352
	Balance mln NAF (NPV)	-475	46	1120	1142		1511
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1215	153	1006	1080		1922
	Lease	-130	0	-178	-178		206
	Purchase of ISLA	0	0	430	430		0
	Investment costs ISLA	0	359	1397	1577		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2643	2895		2157
	Balance mln NAF (NPV)	-259	-432	-85	-518		469

Table 10 Sale to PDVSA, Pessimistic growth path, high health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Island of Curacao	**Revenues mln NAF (NPV)**					
	VA ISLA + contractors operation	-751	40	682	636	1189
	VA contractors investments	0	56	56	64	0
	VA contractors removal/clearing	130	0	-68	-68	96
	VA oil depot	6	0	-3	-3	4
	VA shutdown	-84	8	109	127	123
	VA RdK (lease)	-19	0	-25	-25	29
	Employment effects (personnel benefits)	144	6	-68	-70	96
	Value increase ISLA site	0	0	0	0	0
	Sale of ISLA to foreigner	0	0	430	430	0
	Total revenues	-575	110	1112	1091	1537
	Costs mln NAF (NPV)					
	Investment costs RdK	0	118	0	0	0
	Investment public infrastructure	0	0	0	0	0
	Investment oil depot	8	0	-4	-4	6
	Removal/cleaning costs	190	0	-100	-100	140
	Employment effects (costs contractors)	5	0	4	4	4
	Health costs	-107	-45	-3	-49	203
	Total costs	97	73	-103	-148	352
	Balance mln NAF (NPV)	-671	38	1215	1239	1185
Operator of ISLA	**Revenues mln NAF (NPV)**					
	Gross margin	-1585	82	2557	2377	2627
	Total revenues	-1585	82	2557	2377	2627
	Costs mln NAF (NPV)					
	Operational costs	-1216	153	1006	1080	1922
	Lease	-130	0	-178	-178	206
	Purchase of ISLA	0	0	430	430	0
	Investment costs ISLA	0	359	1397	1577	0
	Cessantia	40	2	-13	-14	30
	Total costs	-1306	514	2643	2895	2157
	Balance mln NAF (NPV)	-259	-432	-85	-518	469

Table 11 Sale to PDVSA, Optimistic growth path, medium health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	582	636		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	-25	-25		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	430	430		0
	Total revenues	-378	119	1017	994		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	0	0		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-57	-22	1	-27		104
	Total costs	146	96	-98	-126		253
	Balance mln NAF (NPV)	-524	23	1115	1120		1410
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	-178	-178		206
	Purchase of ISLA	0	0	430	430		0
	Investment costs ISLA	0	359	1397	1577		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2643	2895		2157
	Balance mln NAF (NPV)	-259	-432	-85	-518		469

Table 12 Sale to PDVSA, pessimistic growth path, medium health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Island of Curacao	**Revenues mln NAF (NPV)**					
	VA ISLA + contractors operation	-751	40	682	636	1189
	VA contractors investments	0	58	56	64	0
	VA contractors removal/clearing	130	0	-68	-68	96
	VA oil depot	6	0	-3	-3	4
	VA shutdown	-84	8	109	127	123
	VA RdK (lease)	-19	0	-25	-25	29
	Employment effects (personnel benefits)	144	6	-68	-70	96
	Value increase ISLA site	0	0	0	0	0
	Sale of ISLA to foreigner	0	0	430	430	0
	Total revenues	-575	110	1112	1091	1537
	Costs mln NAF (NPV)					
	Investment costs RdK	0	118	0	0	0
	Investment public infrastructure	0	0	0	0	0
	Investment oil depot	8	0	-4	-4	6
	Removal/cleaning costs	190	0	-100	-100	140
	Employment effects (costs contractors)	5	0	4	4	4
	Health costs	-57	-22	1	-27	104
	Total costs	146	96	-96	-126	253
	Balance mln NAF (NPV)	-721	15	1210	1217	1284
Operator of ISLA	**Revenues mln NAF (NPV)**					
	Gross margin	-1565	82	2557	2377	2627
	Total revenues	-1565	82	2557	2377	2627
	Costs mln NAF (NPV)					
	Operational costs	-1216	153	1006	1080	1922
	Lease	-130	0	-178	-178	206
	Purchase of ISLA	0	0	430	430	0
	Investment costs ISLA	0	359	1397	1577	0
	Cessantia	40	2	-13	-14	30
	Total costs	-1306	514	2643	2895	2157
	Balance mln NAF (NPV)	-259	-432	-85	-518	469

Table 13 Sale to third party, optimistic growth path, high health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	682	696		1189
	VA contractors investments	0	58	56	64		0
	VA contractors removal/clearing	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	-25	-25		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	865	865		0
	Total revenues	-378	119	1253	1229		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	0	0		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	-103	-148		352
	Balance mln NAF (NPV)	-475	46	1355	1377		1311
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	-178	-178		206
	Purchase of ISLA	0	0	666	666		0
	Investment costs ISLA	0	359	1397	1577		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2879	3131		2157
	Balance mln NAF (NPV)	-259	-432	-321	-754		469

Table 14 Sale to third party, pessimistic growth path, high health costs estimation

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	682	636		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	-25	-25		29
	Employment effects (personnel benefits)	144	8	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	665	665		0
	Total revenues	-575	110	1348	1326		1537
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	0	0		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	6	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	73	-103	-148		352
	Balance mln NAF (NPV)	-671	38	1450	1474		1185
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	-178	-178		206
	Purchase of ISLA	0	0	666	666		0
	Investment costs ISLA	0	359	1397	1577		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2879	3131		2157
	Balance mln NAF (NPV)	-259	-432	-321	-754		469

Table 15 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs + 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case	Base case
Island of Curacao	**Revenues mln NAF (NPV)**					
	VA ISLA + contractors operation	-751	40	646	600	1189
	VA contractors investments	0	56	56	84	0
	VA contractors removal/cleaning	130	0	-68	-68	96
	VA oil depot	6	0	-3	-3	4
	VA shutdown	-84	8	109	127	123
	VA RdK (lease)	-19	0	11	11	29
	Employment effects (personnel benefits)	340	15	-163	-167	222
	Value increase ISLA site	0	0	0	0	0
	Sale of ISLA to foreigner	0	0	0	0	0
	Total revenues	-378	119	587	564	1663
	Costs mln NAF (NPV)					
	Investment costs RdK	0	141	168	189	0
	Investment public infrastructure	0	0	0	0	0
	Investment oil depot	8	0	-4	-4	6
	Removal/cleaning costs	190	0	-100	-100	140
	Employment effects (costs contractors)	5	0	4	4	4
	Health costs	-107	-45	-3	-49	203
	Total costs	97	96	65	42	352
	Balance mln NAF (NPV)	-475	23	522	523	1311
Operator of ISLA	**Revenues mln NAF (NPV)**					
	Gross margin	-1565	82	2557	2377	2627
	Total revenues	-1565	82	2557	2377	2627
	Costs mln NAF (NPV)					
	Operational costs	-1215	153	1006	1080	1922
	Lease	-130	0	56	56	206
	Purchase of ISLA	0	0	0	0	0
	Investment costs ISLA	0	430	1509	1704	0
	Cessantia	40	2	-13	-14	30
	Total costs	-1306	585	2558	2824	2157

	Balance mln NAF (NPV)	-259	-504	0	-448		469

Table 16 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs + 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	800		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/clearing	130	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-575	110	683	661		1537
	Costs mln NAF (NPV)						
	Investment costs RdK	0	141	168	189		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		8
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	96	65	42		352
	Balance mln NAF (NPV)	-671	14	618	620		1185
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1230	1388		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2278	2509		2157

	Balance mln NAF (NPV)	-259	-432	279	-132		469

Table 17 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs - 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	130	0	-68	-68		96
	VA oil depot	5	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-378	119	587	564		1663
	Costs mln NAF (NPV)						
	Investment costs RdK	0	94	112	126		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	49	9	-22		352
	Balance mln NAF (NPV)	-475	70	578	586		1311
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	287	1006	1136		0
	Cessantia	40	2	-13	-14		30

	Total costs	-1306	442	2055	2256		2157
	Balance mln NAF (NPV)	-259	-360	503	120		469

Table 18 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis investment costs - 20%

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/cleaning	139	0	-68	-68		96
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-575	110	683	661		1537
	Costs mln NAF (NPV)						
	Investment costs RdK	0	94	112	126		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	190	0	-100	-100		140
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	97	49	9	-22		352
	Balance mln NAF (NPV)	-671	61	673	683		1185
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	287	1006	1136		0

	Cessantia	40	2	-13	-14		30
	Total costs	-1306	442	2055	2256		2157
	Balance mln NAF (NPV)	-259	-360	503	120		469

Table 19 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: no cleaning costs only demolition costs

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	846	600		1189
	VA contractors investments	0	56	56	64		0
	VA contractors *removal/cleaning*	98	0	-51	-51		72
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-411	119	804	581		1639
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	143	0	-75	-75		105
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	49	73	62	35		317
	Balance mln NAF (NPV)	-460	46	542	546		1322
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0

	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance mln NAF (NPV)	-259	-432	251	-164		469

Table 20 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: no cleaning costs only demolition costs

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	56	84		0
	VA contractors removal/clearing	98	0	-51	-51		72
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-607	110	700	678		1513
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	143	0	-75	-75		105
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	49	73	62	35		317
	Balance mln NAF (NPV)	-656	38	638	643		1196
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	58		206

	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance mln NAF (NPV)	-259	-432	251	-164		469

Table 21 Optimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: cleaning costs + 300%, no change in demolition costs

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	600		1189
	VA contractors investments	0	56	58	64		0
	VA contractors removal/cleaning	195	0	-102	-102		144
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	8	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	340	15	-163	-167		222
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-313	119	553	530		1711
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	286	0	-149	-149		210
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	192	73	-13	-40		422
	Balance mln NAF (NPV)	-505	46	566	570		1289
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2827
	Total revenues	-1565	82	2557	2377		2827
	Costs mln NAF (NPV)						
	Operational costs	-1216	153	1006	1080		1922

	Lease	-130	0	56	56		206
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance mln NAF (NPV)	-259	-432	251	-164		469

Table 22 Pessimistic growth path, high health costs estimation, share RdK in investments (case 4a + 5a) is 10%. Sensitivity analysis: cleaning costs + 300%, no change in demolition costs

		Premature closure - Base case	Case 1 - Base case	Case 4a - Base case	Case 5a - Base case		Base case
Island of Curacao	**Revenues mln NAF (NPV)**						
	VA ISLA + contractors operation	-751	40	646	800		1189
	VA contractors investments	0	56	56	64		0
	VA contractors removal/clearing	195	0	-102	-102		144
	VA oil depot	6	0	-3	-3		4
	VA shutdown	-84	6	109	127		123
	VA RdK (lease)	-19	0	11	11		29
	Employment effects (personnel benefits)	144	6	-68	-70		96
	Value increase ISLA site	0	0	0	0		0
	Sale of ISLA to foreigner	0	0	0	0		0
	Total revenues	-510	110	649	627		1585
	Costs mln NAF (NPV)						
	Investment costs RdK	0	118	140	158		0
	Investment public infrastructure	0	0	0	0		0
	Investment oil depot	8	0	-4	-4		6
	Removal/cleaning costs	288	0	-149	-149		210
	Employment effects (costs contractors)	5	0	4	4		4
	Health costs	-107	-45	-3	-49		203
	Total costs	192	73	-13	-40		422
	Balance mln NAF (NPV)	-701	38	661	667		1163
Operator of ISLA	**Revenues mln NAF (NPV)**						
	Gross margin	-1565	82	2557	2377		2627
	Total revenues	-1565	82	2557	2377		2627
	Costs mln NAF (NPV)						

	Operational costs	-1216	153	1006	1080		1922
	Lease	-130	0	56	56		208
	Purchase of ISLA	0	0	0	0		0
	Investment costs ISLA	0	359	1257	1420		0
	Cessantia	40	2	-13	-14		30
	Total costs	-1306	514	2306	2540		2157
	Balance min NAF (NPV)	-259	-432	251	-164		469

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