GOES/USAID
Mission to El Salvador
Intermodal
Transportation Study

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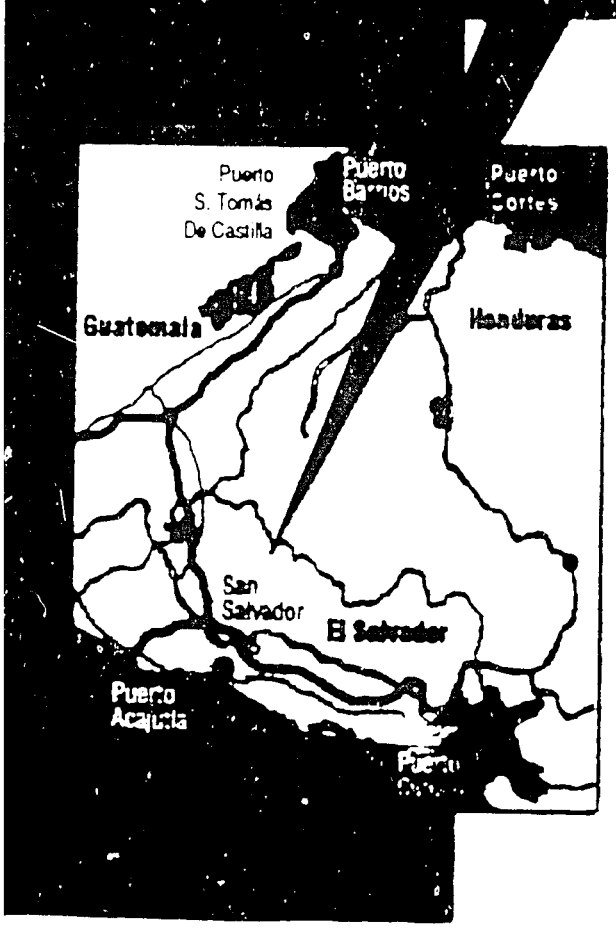

Final Report
TASK 10
INVESTMENT
EVALUATION
prepared by
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June, 1995

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San Salvador June 29, 1995

Mr. Ernesto Girón, CTO
USAID Mission in El Salvador
San Salvador, El Salvador

Ref.:Intermodal Transportation Study
Contract No. 519-0394-C-00-4112-00
Final Report, Task 10 "Investment Evaluation"

Dear Mr. Girón:

In compliance with section C.3.6 of above referenced contract enclosed herewith are 10 (ten) copies, in English, of the Final Report of Task 10 **"Investment Evaluation"**

We are calling this "Final Report" rather than "Final In-Depth Report" because we are now incorporating in one single volume phases 1 (Assessment) and 2 (Analysis) of the Study.

Sincerely yours,

José H. Cosío, P.E.
Team Leader

PN-ABX-462

TASK 10

INVESTMENT EVALUATION

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GLOSSARY OF TERMS

AADT	Average Daily Annual Traffic
DGC	General Directorate of Roads
DUA	Machinery and Equipment Administration
AME	General Directorate for Urbanism and Architecture
GOES	Government of El Salvador
IRR	Internal Rate of Return
NPV	Net Present Value
N.A.	Not Available
V.P.H.	Vehicles per Hour
IVA	Value Added Tax
MIS	Management Information System

10. INVESTMENT EVALUATION

10.1 Introduction

This chapter is concerned with the economic and financial evaluation of the investment programs identified in the subsector chapters, by the concerned agencies or by the modal specialists

First, the programs being evaluated are summarized. Second, the methods applied for economic analysis are described and implemented for highway, port and railway projects The economic evaluation of the proposed highway maintenance program was completed in Chapter 3 and is summarized here. No economic benefits are estimated for the one airport project as decisions will be made almost entirely on financial criteria.

Third, the methodology used in the financial analysis is described and applied to port, railway and airport projects. No financial analysis is performed for individual road programs as they do not directly generate revenues. Instead, Chapter 8 contains recommendations on road user charges in order to meet the sector's future construction and maintenance needs.

The investment programs evaluated include:

10.1.1 Highway Programs

- Routine and periodic maintenance of the existing highway network, both paved and unpaved, to reduce future financial requirements for network rehabilitation.

- Construction of two by-pass routes (North and South) around the San Salvador Metropolitan Area to reduce the impact of urban congestion upon interurban traffic and also alleviate demand upon urban facilities.

- The Northern East-West Highway conceived to open up an underdeveloped region covering approximately the northern third of the country, and provide an alternate route for international traffic serving this area and the Eastern region of the country, as well as part of an alternate route to San Salvador.

10.1.2 Rail Programs

Five scenarios were considered, four to rehabilitate sections of the existing rail network, one of which was discarded in Chapter 4, and one of total closure. The scenarios are:

1. Acajutla - San Salvador (District 3), including a possible spur to the new Nejapa thermoelectric plant, providing for the transport needs of low-valued and other imports from port to capital city.

2. Metapan - San Salvador (District 2), including the construction of a new connection at Apopa linking District 2 and 3 lines to reestablish Apopa - San Salvador service providing for the key transport route for El Salvador's cement production

3. Providing the services in both scenarios 1 and 2 (retaining portions of Districts 2 and 3). In this case, there is the alternative of shipping cement via a new Santa Ana connection, rather than via Apopa, thus possibly attracting additional Acajutla - Santa Ana - Metapán traffic.

4. The San Salvador - Cutuco line (District 1) has been discarded for lack of projected traffic, and should not be retained.

5. The total closure of the rail network remains a major scenario, for which only financial analysis was applicable.

10.1.3 Port Programs

Five programs are considered, three for Acajutla and two for Cutuco.

- **Acajutla**

  - Adapt Pier C to service containers and dry bulks by adding two multi-purpose cranes, providing additional equipment and adding 4 hectares of container yard, effectively providing the port with a true container-handling capability for the first time. It is estimated that the two cranes will have an effective total capacity of 500,000 tons of containers per year.

  - As Pier C's new capacity is fully utilized, implement proposed Specialized Container Terminal by building a new combination breakwater-finger pier (Pier D).

  - As the capacity of the existing dry bulk transport facility becomes fully utilized, implement a grain terminal including an additional conveyor belt system and specialized unloaders.

- **Cutuco**

  - Rehabilitate the existing pier before it ceases to be operational, while also providing road access thus maintaining this historical service and reducing projected demand on the overloaded future road network.

- Build the new container terminal, thus providing a further push for the Eastern Region's development, reducing its land transport costs and the prices of imported goods.

10.1.4 Airport Programs

The El Salvador International Airport is the only commercial facility requiring investment. Major expansion of its passenger terminal and gate facilities is underway and the runway and taxiways have been rehabilitated recently. Therefore, the only program being considered is: the future expansion of the cargo terminal along with new systems and procedures to increase throughput and reduce expansion requirements.

10.1.5 Summary of Evaluated Programs

The programs evaluated are summarized in Table 10.1.1. The total cost of all these investments evaluated for construction during the 2000 - 2015 period, is approximately 12 billion colones (1994 price).

TABLE 10.1.1
List of Programs Evaluated
(Cost in millions of 1994 Colones)

PROGRAM	ACTION	TYPE	COST
Road Programs Maintenance of the Existing Network	routine and periodic maintenance (from 1995 to 2014).	all types	5,758
North Bypass (Alternative 1) (2)	widening and construction	primary and special	1,013
South Bypass (Alternative 3) (3)	construction and widening	primary and special	520
Northern East-West Highway	construction and reconstruction	secondary	3,150
Rail Program (Scenario 3) (4)	rehabilitation and construction	narrow gauge	152
Port Programs Multi-purpose Cranes and Expansion of Container Yard (Pier C) - Acajutla	installation and construction	equipment and yard	179
Specialized Container Terminal (Pier "D") - Acajutla	construction	container terminal	700
Grain Terminal - Acajutla	installation	equipment	132
Pier Rehabilitation - Cutuco	rehabilitation	general cargo finger pier	44
Spec. Container Terminal - Cutuco	construction	container terminal	437
Airport Programs Cargo Terminal - Scenario 4	expansion	cargo	38
TOTAL			12,114

(1) If it were feasible to maintain all paved and unpaved roads, total cost is estimated at 9,348 million over 20 years.
(2) CA-8- Sitio del Niño-Apopa-San Martin, Road to Tonacatepeque-Cojutepeque.
(3) La Cuchilla-Santa Tecla-Junction to La Libertad-San Marcos, Santo Tomás-Ilopango. The economic evaluation considers La Libertad-San Marcos, as a special highway. This was subsequently change to primary, reducing total cost to ¢ 439 million.
(4) Acajutla-San Salvador, Metapán-San Salvador (via Texis Junction, Santa Ana, Sitio del Niño), Santa Ana connection and Nejapa spur.

Source: Frederic R. Harris, Inc.

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10.2 Economic Analysis

The future of El Salvador's transportation network must take into account key characteristics of its geography and recent history:

- Geographical Factors
  - The concentration of economic activity in the areas around San Salvador
  - The Country's difficult topography. The topographical constraints include: the coastal area between Acajutla and La Libertad, the volcanoes and other mountains surrounding San Salvador, and the largely mountainous terrain in most of the northern region.
  - Minimum cost routes for most traffic are through the San Salvador area
  - The Country's difficult access to the Caribbean and the Atlantic Ocean, where a very large share of its markets are concentrated.
  - The importance of traffic with other countries in the region.
  - The short distance of average trips, leading to a large proportion of small trucks and their sensitivity to small differences in distances, transport costs and travel times.
  - The lack of a domestic (national) port container service.
  - The favorable location of the international airport.
- Historical Factors
  - The recent armed conflict which led to depopulation and declines in economic activity in major areas of the country. Current growth patterns indicate that people and businesses are quickly filling this void, leading to a likelihood of regionally-concentrated growth patterns in the immediate future.
  - The traditional under investment in maintenance of transport facilities was increased by the conflict, as well as delays or lack of their rehabilitation.

These and other factors significantly contribute to the results of the economic analysis.

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10.2.1 Methodology

The standard benefit-cost analysis is applied whereby economic benefit and cost streams computed by applying shadow or economic pricing, are compared to obtain indicators such as Net Present Value and Internal Rate of Return. In order to compare the results of feasibility studies for already funded projects with those proposed here the shadow prices adopted by the General Highway Directorate are used. See Annex 10.2.1 for a description of this methodology.

However, the techniques used to estimate benefits are somewhat different than those adopted on most transport investment feasibility studies:

- Base year (1992) demand was estimated by origin-destination pair and the TRANUS transport model of the key intermodal network was calibrated with observed traffic. Demand was then projected based upon expected national and regional growth rates in population, economic activity and user mode preferences (i.e., passenger preference for private cars, etc.). Due to the recent conflict, past growth rates of traffic on existing facilities are not considered representative of future growth.

- Growth rates are projected to be somewhat higher in the Eastern Region, as that region recuperates from the war and, to a lesser extent, in the San Salvador area due to the continued preference for locating businesses there and the continued rural-urban migration. See traffic analysis in Chapter 2.

- The TRANUS model has been used to assign traffic to the network, rather than the traditional distinction of existing, diverted and generated traffic. This tool reflects more accurately how users will respond to changes in the supply of facilities and resulting transportation costs, resulting in significant shifts among alternate routes, especially : 1) among port services at Acajutla, Cutuco and Quetzal, as well as cross-isthmus services via Santo Tomás de Castilla, Puerto Cartés or the Panama Canal; 2) between the CA-1 (Panamerican) and CA-2 Highways (Coastal), east of San Salvador; and access to the CA-2 via La Libertad or Zacatecoluca; 3) among routes through, north of or south of San Salvador.

- The model also provides estimates for the benefits of specific investment programs. These are obtained by running the model for each of the horizon years with and without the improvements brought about by each investment program. This approach permits obtaining an estimate of the savings brought by each program in total nation-wide transportation costs.

- Regarding the economic analysis of port investments, the approach was to estimate the comparative advantages of principal ports for handling different cargo types. The analysis assumes equivalent port charges among competing ports, and compares generalized marginal costs and estimates marginal cargo shifts in order to estimate benefits

The Study made a considerable effort to obtain the information needed to economically evaluate these programs. However, the results are preliminary in the sense that some of these investment programs lack sufficient definition, analysis of alternatives and full feasibility studies. Demand, costs, benefits, and revenues are estimated subject to the information available at the time of this Study. In some cases the analysis may be considered at approximately the level of pre-feasibility, while others are at the level of program profile or project identification. The latter description is especially applicable to the bypass programs, for which urban traffic data are not sufficient.

10.2.2 Economic Analysis of Highway Programs

Of the four programs analyzed, the maintenance of the existing paved highway network has the highest average internal rate of return of 108 %. This analysis of the highway maintenance programs is performed in Chapter 3 and is a typical result in areas in which there is considerable underinvestment, especially for highway maintenance, where its postponement results in subsequent major road deterioration and considerable rehabilitation costs.

In addition, new investments were considered for the main corridors, as defined in Chapter 2, based upon preliminary capacity analysis completed in Chapter 3. Other road investments are not considered despite their importance to the country's development. These include improvements and maintenance of primary, secondary and rural roads, which are not a part of the network studied.

Capacity analysis was used to identify the three remaining highway investment programs. The number of programs identified is limited due to the extensive investments currently underway and planned. They are evaluated here using the construction cost estimates presented in Chapter 3 and summarized in Table 10.2.1. The maintenance cost estimates were obtained from the maintenance analysis for representative links, selected from among those analyzed in Chapter 3, where routine and periodic maintenance tasks are also defined. These are presented in Table 10.2.2.

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TABLE 10.2.2
Highway Maintenance Costs by Road Type and Traffic Level
(in million of 1994 colones/km)

Road Type and Traffic Level	Traffic on Representative Link (vpd)	Routine Maintenance Annual Cost	Periodic Maintenance	
			Annual Cost	First Operation after construction
Special (6 lanes)	N.A.	0.074	2.31	7 years
Special (4 lanes)	10,600	0.049	1.54	7 years
Primary-low traffic	1,060	0.026	0.557	11 years
Primary-high traffic	2,986	0.026	0.556	8 years
Secondary	1.517	0.022	0.452	9 years

Source: Maintenance cost analysis of representative links, Chapter 3, Frederic R. Harris, Inc.

N.A - Not available as there is no representative link. Computed at 1.5 times costs of 4-lane roads.

The results of the economic analysis for these programs are shown in Table 10.2.3 and in more detail in Annex 10.2.2.

The bypass programs are highly feasible due to reduced user costs and travel times. Only one alternative was analyzed for each bypass program, each presenting very high IRR's and NPV's. The choice of other alternatives will affect the feasibility indicators but not their overwhelmingly positive results. The benefits may be underestimated regarding the impact of reduced interurban traffic upon urban traffic congestion. Also, air pollution will increase less than without these bypasses, a factor not quantified here.

The analysis does not indicate that the Northern East-West Highway is feasible, although specific sections may be feasible. However, this result was expected for a penetration road of this nature for which activity location changes, origin-destination matrix adjustments, and regional development impacts are likely to be significant and are not considered in model computations. They are especially relevant for new construction, and more so in areas where infrastructure is practically non-existent.

Thus, these programs are potentially feasible and merit further study. As a result of this analysis, the Consultant recommends that GOES consider implementing the pre-investment program proposed in this chapter .

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TABLE 10.2.3
Economic Analysis of Highway Programs
(Selected Alternatives in Millions of 1994 Colones)

PROGRAM	LINKS	INVESTMENT COST	OPENING YEAR (1)	NPV	IRR %	AADT 2015
Maintenance of the Existing Network	Paved network	3,184	1995 - 2014	4,687	108.7	
	Unpaved network (2)	2,574		N.A	N.A	
	Total	*5,758*				
North Bypass (Alt. 1)	Inters. CA-8 - Sitio del Niño	106.79	2010			3962
	Sitio del Niño - Apopa	229.33	2010			11913
	Apopa - San Martín	269.58	2015			1661 (3)
	Ilopango Connector	24.25	2010			11182
	Calle Tonacatepeque - Cojutepeque	377.90	2010			28622
	Total	*1,013.41*		4,574	33.1	
South Bypass (Alt. 3)	La Cuchilla-Sta.Tecla	139.15	2010			25592
	Sta Tecla-Junction. La Libertad	76.78	2010			16472
	Junction. La Libertad-San Marcos	66.05	2010			1346(3)
	Santo Tomás - Ilopango (1)	138.38	2010			8090
	Total	*520.36*		7,222	43.3	
Northern East-West Highway (4)	Metapán - N Concepción	517.21	2010			745
	N Concepción - Junction. CA-4	44.25	2010			745
	Junction. CA-4 - Chalatenango	68.83	2010			2195
	Osicala - Inter. CA-7 (km 18)	823.67	2010			2715467
	Chalatenango - Sensuntepeque.	1,226.73	2015			1096
	Sensuntepeque - Osicala	71.29	2015			271
	Sensuntepeque. - Intersection S.Vicente	397.86	2015			2949
	Total	*3,149.74*		*(4,135)*	48.0	
TOTAL		10,441.51		12,348		

Source: Frederic R. Harris, Inc.,N.A.-not available

(1) Opening year based on identified capacity constraints and, for the Northern East-West Highway, based on projected traffic

(2) Non-paved maintenance needs are estimated here as greater than projected. Simple average of IRR'S of 40 links covering approximately 95% of the paved network.

(3) Feasibility analysis will require detailed regional development studies, which may identify benefits leading to findings of feasibility for some of the highway links of this program

(4) 2.2 to 2.3 standard-vehicles/AADT

10 2 3 Railway Programs

Based upon the analysis completed in Chapter 4, three scenarios are considered for rehabilitating sections of the existing rail network, which are:

1. Acajutla - San Salvador, including a spur to the Nejapa thermoelectric plant.

2. Metapán - San Salvador, including the possible construction of the Apopa connection.

3. Providing both these services, with either the Apopa or the Santa Ana connection[1].

For the purpose of evaluation, these facilities are asssumed to be completely rehabilitated/built by 2005. Sensitivity analysis is performed for completion by the year 2000. Financial costs for maintaining the existing network in the meanwhile are not included. Rail traffic was projected based upon potential demand, concentrated in a few low-valued products. Cement, and its plant's fuel and puzzolana needs, represent 79% of this potential for 2015. Unconstrained lime deposits in the Metapán area have been confirmed. Traffic potential also assumes that all Nejapa thermoelectric plant fuel needs, 13% of 2015 potential, will be carried by rail once the Nejapa spur and the rehabilitation of the Acajutla-San Salvador line is completed.

The key benefits they would provide would be reductions in road congestion, especially in the region surrounding San Salvador. These are low because of recent competitive highway improvements and relatively slower economic growth in the Western Region. The TRANUS model measures rail benefits directly by comparing scenarios with all the committed and proposed highway programs, with and without the improved rail network. For example, with the road and rail service, 57.4 % of Metapán cargo traffic to San Salvador is projected to travel via rail. Benefits will vary with actual rail traffic, an issue treated in the sensitivity analyses presented below in Annex 10.2.3.

Economic benefits and costs of rehabilitation are estimated by applying shadow prices. The demand categories and benefit estimates as computed tend to favor rail rehabilitation feasibility. A special low-value cargo category was defined while unconstrained traffic potential is assumed to be actual demand.

Costs exclude transfer payments such as right of way (encroachment reduction) and indemnification of staff. Other benefits not quantified in this study include reduced air and water pollution, due to reduced highway V/C ratios and better levels of service in this

[1] Scenario 4, San Salvador-Cutuco, was excluded in the Rail Analysis of Chapter 4.

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central region, as well as reduced risk of accident and theft losses when comparing improved rail with highway services Reduced highway maintenance cost calculated in Annex 10 2.3 is minimal, especially given low rail share of traffic Fuel savings are also not significant given lower real prices and economic price conversion factors

The economic analysis results indicate that rail rehabilitation is not feasible given all potential traffic and low urban congestion.[2] Sensitivity analysis was carried out for variations in traffic, and earlier opening year. If cement-related traffic is about half the level projected and, for continuity purposes, opening is anticipated to the year 2000, the IRR'S are even lower. If these investments had been considered before the parallel highway investments were made, the results may have been different, however, if actual urban street capacity to handle interurban traffic, were less and congestion were heavier, rehabilitation according to Scenario 3 would be marginally feasible, either via Apopa or Santa Ana. In this case, it may be more cost effective to alleviate this congestion by other policy or investment measures.

These results are summarized in Table 10.2.4.

TABLE 10.2.4
Economic Analysis of Rail Rehabilitation Scenarios
(in million 1994 colones)

Rehabilitation Scenario	Length in km	Financial Cost	IRR %	NPV
Road Scenario				
1. Acajutla-San Salvador	103.0	95.27	-8.85	-196
2B. Metapán-Apopa-San Salvador	135.5	94.38	5.31	-75
2A. Metapán-San Salvador (existing)	138.0	62.68	4.07	-87
3B. Both services with Apopa connection	234.0	173.29	6.25	-134
3C. Both services with Santa Ana connection	215.0	203.72	6.15	-144
Sensitivity Analysis				
3C. With half the traffic (less cement growth)	215.0	203.72	-0.53	-2.33
3C. Opening year 2000	215.0	203.72	3.23	-282
3C. Heavier urban congestion (2)	215.0	203.72	12.04	8

Sources: FENADESAL and Frederic R. Harris, Inc.

(1) Annex 10.2.3 contains additional sensitivity analysis and foreign exchange savings in vehicle operations without significant impacts.
(2) Average of 2000 standard VPH on the model's urban highway links. The intermodal scenario, without road investments other than those committed, provides somewhat higher indicators.

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[2] An average of 4000 standard vehicles per hour of interurban traffic on theoretical urban road links, representing all urban streets used by interurban traffic on specific routes; container traffic potential, discussed in Chapter 4, is not included.

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The Consultant's recommendation is to close FENADESAL, except in the following circumstances in which rail rehabilitation might be possible:

- Key users could commit to use rail service for at least 90% of their traffic under appropriate conditions, especially the cement plants and the private power generator. Initial contacts indicate this is unlikely.
- Funds are unlikely by 2005 for the proposed urban bypasses.
- All funds can be made available for the needed railroad investments.
- The relocation of families encroached on rail right-of-way is socially feasible.
- The GOES attributes great importance to mitigating future increases in air pollution, risk of accidents and certain non-economic criteria.

If the first two factors and most of the others were favorable, GOES may nevertheless still wish to consider rehabilitation according to Scenario 3.

10.2.4 Economic Analysis of Port Programs

Based upon the analysis completed in Chapter 5, economic feasibility is estimated for the five port investment programs described above.

For this purpose, the analysis of competition among the ports begun in Chapter 5, is expanded. The comparative advantages among three ports - Cutuco, Acajutla and Quetzal - are analyzed by type of cargo (general cargo and containers) and external zone of origin or destination (Atlantic and Pacific). The key marginal generalized cost items (including transport and time costs) are maritime and land travel. The analysis is based upon the following assumptions: 1) most Pacific cargo comes from the north and Atlantic cargo via the Panama Canal to the south, 2) All three ports have the same, or similar, unit operating costs and tariffs for each cargo type.

Tables 10.2.5 present these cost comparisons for each of the projection years and scenarios. In the trend scenario, the bottleneck represented by urban and peri-urban congestion around San Salvador tends to increasingly separate the markets for Cutuco and Acajutla services, while the distance between Quetzal and Acajutla, effectively increased by the border costs and delays, tends to separate the markets for these ports. In the road scenario, the San Salvador barrier is largely solved with expensive bypass investments. Greater cooperation between Guatemala and El Salvador would reduce the cost of passing the border. Both would enhance competitiveness between these ports. Also, note that Pacific traffic will tend to prefer Acajutla while Atlantic traffic may prefer Cutuco.

TABLE 10.2.5
Comparative Advantages between Ports by Type of Cargo and Scenario

ATLANTIC CARGOES

COMPARATIVE ADVANTAGE OF CUTUCO OVER ACAJUTLA - CARGOES TO SAN MIGUEL

TYPE OF CARGO/ ROUTE	VIA	DISTANCE	GENERALIZED COST 2000	2005	2010	2015
ROAD SCENARIO						
GENERAL CARGO						
Acajutla - San Miguel	road	222.4	141.4	134.5	132.5	133.6
Acajutla - Cutuco (additional cost)	maritime	210.0	72.7	72.7	72.7	72.7
Cutuco - San Miguel	road	48.5	41.1	41.1	32.8	34.6
Comparative advantage			173.0	166.1	172.3	171.6
CONTAINERS						
Acajutla - San Miguel	road	222.4	162.5	154.4	150.3	156.0
Acajutla - Cutuco (additional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Miguel	road	48.5	55.9	56.0	48.4	49.1
Comparative advantage			202.1	193.9	197.4	202.4
TREND SCENARIO						
GENERAL CARGO						
Acajutla - San Miguel	road	222.4	141.4	138.1	145.2	164.4
Acajutla - Cutuco (additional cost)	maritime	210.0	72.7	72.7	72.7	72.7
Cutuco - San Miguel	road	48.5	41.1	41.1	34.2	34.4
Comparative advantage			173.0	169.6	183.6	202.6
CONTAINERS						
Acajutla - San Miguel	road	222.4	162.5	158.2	162.3	179.7
Acajutla - Cutuco (additional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Miguel	road	48.5	55.9	56.0	48.3	48.8
Comparative advantage			202.1	195.7	209.5	226.4

COMPARATIVE ADVANTAGE OF CUTUCO VS. ACAJUTLA - CARGOES TO SAN SALVADOR

TYPE OF CARGO/ ROUTE	VIA	DISTANCE	GENERALIZED COST 2000	2005	2010	2015
ROAD SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	70.4	69.7	60.3
Acajutla - Cutuco (additional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Salvador	road	180.5	151.5	145.5	139.8	114.0
Comparative disadvantage			13.3	20.4	25.4	41.8
TREND SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	77.2	82.8	115.5
Acajutla - Cutuco (additional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Salvador	road	180.5	151.5	150.5	153.4	185.2
Comparative disadvantage			13.3	22.2	24.9	25.8

COMPARATIVE ADVANTAGE OF ACAJUTLA OVER QUETZAL - CARGOES TO SAN SALVADOR

TYPE OF CARGO/ ROUTE	VIA	DISTANCE	GENERALIZED COST 2000	2005	2010	2015
ROAD SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	70.4	69.7	60.3
Quetzal - Acajutla (cost savings)	maritime	230.0	104.7	104.7	104.7	104.7
Quetzal - San Salvador	road	180.5	357.3	359.0	351.4	353.3
Comparative disadvantage			392.7	393.3	386.4	397.7

Note. The major difference between the scenarios is that the road one considers construction of the San Salvador bypasses. The generalized costs include the value of user time.

Source Costs calculated by the TRANUS model, Frederic R. Harris, Inc.

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TABLE 10.2.5 (continue...)
Comparative Advantages between Ports by Type of Cargo and Scenario

PACIFIC CARGOES

COMPARATIVE ADVANTAGE OF CUTUCO OVER ACAJUTLA - CARGOES TO SAN MIGUEL

TYPE OF CARGO/ROUTE	VIA	DISTANCE	GENERALIZAD COST 2000	2005	2010	2015
ROAD SCENARIO						
GENERAL CARGO						
Acajutla - San Miguel	road	222.4	141.4	134.5	132.5	133.6
Acajutla - Cutuco (adicional cost)	maritime	210.0	72.7	72.7	72.7	72.7
Cutuco - San Miguel	road	48.5	41.1	41.1	32.8	34.8
Comparative advantage			27.6	20.7	27.0	26.3
CONTAINERS						
Acajutla - San Miguel	road	222.4	162.5	154.4	150.3	156.0
Acajutla - Cutuco (adicional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Miguel	road	48.5	55.9	56.0	48.4	49.1
Comparative advantage			11.0	2.8	6.3	11.3
TREND SCENARIO						
GENERAL CARGO						
Acajutla - San Miguel	road	222.4	141.4	138.1	145.2	164.4
Acajutla - Cutuco (adicional cost)	maritime	210.0	72.7	72.7	72.7	72.7
Cutuco - San Miguel	road	48.5	41.1	41.1	34.2	34.4
Comparative advantage			27.6	24.3	38.3	57.3
CONTAINERS						
Acajutla - San Miguel	vial	222.4	162.5	158.2	162.3	179.7
Acajutla - Cutuco (adicional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Miguel	vial	48.5	55.9	58.0	48.3	48.8
Comparative advantage			11.0	4.6	18.4	35.3

COMPARATIVE ADVANTAGE OF CUTUCO VS. ACAJUTLA - CARGOES TO SAN SALVADOR

TYPE OF CARGO/ROUTE	VIA	DISTANCE	GENERALIZED COST 2000	2005	2010	2015
ROAD SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	70.4	69.7	60.3
Acajutla - Cutuco (adicional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Salvador	road	160.5	151.5	145.5	139.8	114.0
Comparative disadvantage			-177.6	-170.7	-165.7	-149.3
TREND SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	77.2	82.8	115.5
Acajutla - Cutuco (adicional cost)	maritime	210.0	95.6	95.6	95.6	95.6
Cutuco - San Salvador	road	160.5	151.5	150.5	153.4	185.2
Comparative disadvantage			-177.6	-168.9	-166.2	-165.3

COMPARATIVE ADVANTAGE OF ACAJUTLA OVER QUETZAL - CARGOES TO SAN SALVADOR

TIPE OF CARGO/ROUTE	VIA	DISTANCE	GENERALIZED COST 2000	2005	2010	2015
ROAD SCENARIO						
CONTAINERS						
Acajutla - San Salvador	road	90.6	69.3	70.4	69.7	60.3
Acajutla - Cutuco (adicional cost)	maritime	230.0	104.7	104.7	104.7	104.7
Quetzal - San Salvador	road	160.5	357.3	359.0	351.4	353.3
Comparative disadvantage			183.4	184.0	177.1	188.4

Note: The major difference between the scenarios is that the road one considers construction of the San Salvador bypasses. The generalized cost include the value of user time

Source: Cost calculate by the TRANUS model, Frederic R. Harris, Inc

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The economic benefits to be derived and the analysis performed for each of the programs are as follows

a Acajutla Container Facilities

The multipurpose cranes on Pier C, the expanded container yard, and the subsequent construction of the specialized container terminal at Acajutla (Pier D) reduce ground transportation costs from Quetzal and, to a lesser extent, Santo Tomás de Castilla These cost savings are significant. Other economic development benefits are not quantified including the enhanced competitiveness of El Salvador's manufacturing sector and overall greater dependability of doing business. Therefore, both are feasible.

Benefits are estimated by comparing marginal generalized costs (transportation costs and travel time) for typical O-D pairs in TRANUS scenarios with and without container access to Acajutla These are then prorated for each horizon year among existing container handling capacity and additional container traffic to be handled at Piers C and D An additional benefit of reduced harbor wave patterns is attributable to Pier D's breakwater function. It is computed in Chapter 5 and added to the economic benefits computed in this chapter in terms of reduced ship time in port as well as port operating costs for handling dry bulks at Pier B.

b. Acajutla Grain Terminal

The benefits expected from the proposed grain terminal are estimated in Chapter 5 regarding reductions in port costs by conveyor belt versus hauling by truck. With only these benefits, the investment is almost feasible. Other significant benefits can be derived from reduced on-pier traffic congestion and accident risk. Although these benefits can only be estimated with a complete port traffic study not presently available, it is evident that including these benefits would lead to clear program feasibility.

c. Cutuco Pier Rehabilitation

Additional TRANUS scenarios were run without the operation of the existing Cutuco Pier, thus simulating the impact upon the network of failing to rehabilitate it. This was compared with another scenario, with the Cutuco pier in operation and all road investments, including access to the port of Cutuco. The projected general cargo traffic for Cutuco would thus be diverted, largely to Acajutla. Comparisons of marginal generalized costs (including travel time) with and without this access provided the benefit estimates. Note that Cutuco's comparative advantage for serving the Eastern Region is enhanced by the fact that most of these cargoes come from the Atlantic via the Panama Canal, to which Cutuco is somewhat closer. The economic cost of not rehabilitating the existing Cutuco pier is also high, assuming the Rail District 1 service is terminated and highway access to Cutuco is provided. Pier rehabilitation is feasible for immediate implementation.

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d Cutuco Specialized Container Terminal

Finally, the benefits derived from a specialized container terminal at Cutuco were computed by comparing scenarios with and without container service, under two road access scenarios: 1) The trend scenario, whereby future highway bottlenecks around San Salvador would not be solved and 2) given the proposed highway programs, container service at Acajutla and the resulting lower projected Salvadorean traffic at the terminal.

The analysis does not include the development impact to be derived by the possible development of port-related industrial free zones; a further push for the Eastern Region's development, made possible by reduced prices for imported goods in the region; nor does it consider potential demand at this facility to service Honduras, other Central American countries, and trans-istmic traffic.

Without these additional benefits and traffic sources, there are not sufficient benefits for feasibility. Once again, the share of Atlantic container traffic will make a significant difference to the feasibility of this facility, as the comparative advantage of Cutuco to service the Eastern Region over Acajutla for Pacific traffic is minimal in the more likely road scenario. See recommendations on carrying out the feasibility study for this program in the pre-investment section of this chapter.

The results of these analyses are presented in Table 10.2.6

TABLE 10.2.6
Economic Analysis of Port Programs
(in million 1994 colones)

Port Project	Investment Cost	Starting Year	IRR %	NPV
Acajutla Multi-purpose Cranes and Container Yard (Pier C)	179	2000	22.02	128
Specialized Container Terminal (Pier "D")	700	2005	18.18	733
Grain Terminal	132	2010	10.82	(42)
Cutuco Pier Rehabilitation	44	1998	16.85	21
Specialized Container Terminal - Trend Scenario Road Scenario	438	2010	7.62 2.79	(366) (485)
TOTAL	1,493			376

Source: Frederic R. Harris, Inc.

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Regarding future port container services, the Consultant proposes GOES carry out the following decision sequence:

- Install the first multi-purpose crane on Acajutla's Pier C and expand container yard.

- Undertake Cutuco container terminal feasibility study, following recommendations made in the pre-investment section of this chapter.

- Market Acajutla container services and monitor the operations. Reestimate optimum investment year and likely capacity increase for Pier C's second crane. Initial capacity estimates for Pier C are 500,000 tons of container cargo per year, 300,000 for the first, and 200,000 for the second, with a possibility of both cranes handling up to a total of 700,000, if there are not traffic congestion problems at the pier.

- Prepare Acajutla Master Plan described below.

- Install second crane.

- Decide on future container terminal needs, investment years and locations.

10.3 Financial Analysis

This section describes the financial evaluation of the investment programs identified in the subsector charters. For the port, railway and airport projects, the key financial indicators are summarized and discussed. For the highway subsector, no financial analysis is performed for individual projects, as they do not directly generate revenues. Instead, this chapter summarizes the subsector financial programming and discusses ways to solve short and medium term cash flow deficits.

10.3.1 Highway Subsector

The consultant has projected and compared highway subsector fiscal revenues and costs for the 1995-2014 period . Fiscal revenues include registration fees, vehicles and spare parts import duties and value added taxes, fuel (gasolines and diesel) surcharges, subsidies, and other revenues (driver license fees, vehicle plates fees, transit and police fines, and vehicle property-related taxes). Costs include current expenses, entailing the Ministry of Public Works's transportation-related functioning costs, DGC, DUA, and AME functioning costs, emergency maintenance costs, and capital costs, (urban road investment, maintenance of interurban unpaved and paved roads, debt service of completed and on-going projects, GOES's participation of on-going projects, and proposed new construction costs).

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The consultant has proposed a routine and periodic maintenance program for the existing highway network that reduces future financial requirements for network rehabilitation and minimizes total maintenance costs, but demands higher funds in the initial years. Also, road reconstruction completed in the past few years and currently underway, is requiring unprecedented financial resources, much of which is being financed with external loans, thus substantially increasing debt service obligations for the next twenty years. In addition, proposed construction of two by-pass routes around San Salvador metropolitan area and construction of the Northern East-West Highway in the next decade, will necessitate additional funds for highway construction.

The above highway subsector costs, together with a one-time reduction in subsector revenues due to reduced import duty fees promulgated in 1995 and programmed for 1996, result in projected subsector costs higher than projected revenues for the next ten years, as presented in Table 10.3.1[3].

The consultant has carried out sensitivity analysis, identifying possible courses of action to overcome the projected deficit. Those include:

- **Revenue-enhancing mechanisms:**
  - **Eliminate preferential diesel fuel prices.**
  - **Increase import duty fees to 1994 levels.**
  - **Increase IVA to 14%.**
- **Cost reduction mechanisms:**
  - **Reduce current cost by 20%.**
  - **Reduce investment costs by 20%.**
  - **Reduce interest rates for ongoing projects by 20%.**

[3] Chapter 3 presents full details of subsector revenues and costs projections

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TABLE 10.3.1

FISCAL REVENUES AND COST PROJECTIONS FOR THE HIGHWAY SUBSECTOR - 1995 - 2014

(VALUES IN 1994 MILLION COLONES))

ITEM	1995	[illegible]	[illegible]	1998	1999	2000-2004	2005-2009	2010-2014	TOTAL 1995-2014
FISCAL REVENUES	724.58	613.69	674.44	739.89	810.35	5,392.50	8,222.38	12,361.34	29,539.17
COSTS									
CURRENT COSTS	204.50	214.73	225.47	236.74	248.58	1,442.19	1,840.61	2,349.15	6,761.97
CAPITAL COSTS	750.21	767.66	772.20	822.47	852.19	4,479.83	6,578.92	7,134.74	22,158.21
TOTAL COSTS	954.71	982.39	997.67	1,059.21	1,100.77	5,922.02	8,419.53	9,483.89	28,920.18
SURPLUS (DEFICIT)	(230.13)	(368.70)	(323.23)	(319.32)	(290.42)	(529.52)	(197.15)	2,877.45	618.99

SOURCE: FREDERIC R. HARRIS,INC.

Table 10.3.2 presents the resulting revenue increase or cost reduction resulting from the above courses of action. As noted, a single revenue-enhancing or cost- reduction mechanism does not eliminate by itself the projected deficit for the 1995-1999 period Furthermore, each cost-reduction mechanism does not free up enough resources to overcome the financial deficit projected for the first two five-year periods.

The cost reduction mechanisms are predicated on increased private participation in highway maintenance, construction, and financing, thus resulting in lower overall highway subsector costs. The consultant has also proposed to eliminate the preferential diesel fuel prices. With cost reduction mechanisms and subsidy elimination, enough resources are generated to overcome the projected subsector deficit.

10.3.2 Rail Subsector

Based on the analysis developed by the modal expert in Chapter 4, six scenarios were considered for financial analysis, which are

- Scenario 1 - Retain Acajutla - San Salvador Service, including a spur to the Nejapa thermoelectric power plant.
- Scenario 2A - Retain Metapán - San Salvador Service Via Existing Route.
- Scenario 2B - Retain Metapán - San Salvador Service Via Apopa Connection.
- Scenario 3B - Retain Acajutla - San Salvador Service, including a spur to the Nejapa thermoelectric power plant, and Metapán - San Salvador Service Via Apopa Connection.
- Scenario 3C - Retain Acajutla - San Salvador Service, including a spur to the Nejapa thermoelectric power plant, and Metapán - San Salvador Service Via Santa Ana Connection.
- Scenario 5 - Total Closure of the Railroad System.

TABLE 10.3.2

SENSITIVITY ANALYSIS OF HIGHWAY SECTOR TO REVENUE INCREASES OR COSTS REDUCTIONS 1995 - 2014

(VALUES IN 1994 MILLION COLONES))

ITEM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2000-2004	2005-2009	2010-2014	TOTAL 1995-2014	
SUPERAVIT (DEFICIT)	(230.13)	(388.70)	(323.23)	(319.32)	(290.42)	(529.52)	(197.15)	2,877.45	618.99	(1,531.79)
REVENUE-ENHANCING										
ELIMINATE SUBSIDIES	268.86	273.74	278.97	284.59	290.65	1,561.21	1,798.56	2,142.97	6,899.55	1,396.81
INCREASE IMPORT DUTIES (1)	45.28	229.77	248.35	268.51	290.33	1,913.28	2,838.67	4,224.77	10,058.96	1,082.24
INCREASE IVA TO 14%	151.12	155.53	166.83	178.98	191.97	1,213.90	1,730.90	2,477.77	6,267.00	844.43
COST CONTROL										
REDUCE 20% CURRENT COSTS	40.80	42.85	45.09	47.35	49.72	288.44	388.12	469.83	1,352.40	226.01
REDUCE 20% INVESTMENT COSTS (2)	37.99	52.29	71.45	83.72	94.91	256.50	627.90	719.30	1,944.06	340.36
REDUCE INTEREST RATES BY 20%	0.00	6.99	17.52	29.70	39.22	234.75	234.75	234.75	797.68	93.43

(1) SETS IMPORT DUTIES TO ITS 1994 LEVELS
(2) ONGOING AND PROPOSED PROJECTS

SOURCE FREDERIC R HARRIS, INC.

All other scenarios and alternatives within scenarios were found not worthy of additional financial analysis and no cash flow forecasts were prepared for them. Chapter 4 presents a detailed description of the key elements considered in preparing the financial analyses for the aforementioned scenarios and Table 10.3.3 summarizes the resulting financial indicators.

Revenues include net liquidation values of proposed closures for each scenario. Costs include track rehabilitation, bridge repair/rehabilitation, new construction (when applicable), encroachment correction, indemnization, and operating costs.

Based on the results presented in Table 10.3.3 and Chapter 4, the following conclusions are drawn:

- Overall financial performance: With the exception of Scenario 5 - Total Closure of the Railroad System, all scenarios show negative cash flows and benefits to costs ratios between 0.4 and 0.5, at a 12% annual discount rate. Therefore, based on financial performance only, the preferred alternative is to close the system down at the earliest possible time.

- If total closure of the system is not economically or socially acceptable, then, from a financial perspective, the best alternatives are those requiring the least investment, Scenario 1 - Retain Acajutla - San Salvador and Scenario 2A - Retain Metapán - San Salvador.

- If Scenario 3 - Retain Acajutla - San Salvador and Metapán - San Salvador, is the preferred alternative from a social or economic perspective, then Scenario 3S, with the Santa Ana connection, would minimize financial losses.

- Considering operating revenues and costs only, Scenarios 1 and 3S present the highest present value of operating margin (operating revenues less operating costs), although they are still negative. Scenario 3S would also require diminishing operating subsidies throughout time and is projected to generate positive operating margins by the year 2008.

The above financial results are highly dependent on the railroad attracting all potential traffic from the Nejapa power and cement plants in Metapán. Traffic projections indicate that the Nejapa power plant would provide more than 70% of the total projected traffic on the Acajutla - San Salvador line. The cement factories in Metapán would provide all of the projected traffic on the San Salvador - Metapán line.

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TABLE 10.3.3

FINANCIAL INDICATORS OF RAILWAY SUBSECTOR SCENARIOS

(MONETARY VALUES IN 1994 MILLION COLONES)

SCENARIO	[illegible]	PRESENT VALUE OF COSTS	NET PRESENT VALUE	RATIO OF REVENUES TO COSTS	PRESENT VALUE OF OPERATING MARGIN
SCENARIO 1	90.67	214.16	(123 49)	0 42	(65 13)
SCENARIO 2A	104.92	247.26	(142 34)	0.42	(92 58)
SCENARIO 2B	102.49	236.26	(133 77)	0 43	(68 17)
SCENARIO 3B	175.47	404.37	(228 91)	0 43	(111 48)
SCENARIO 3C	212.90	436.31	(223 41)	0.49	(66 22)
SCENARIO 5	200.00	25.68	174 32	7 79	N A

SCENARIO 1: RETAIN ACAJUTLA - SAN SALVADOR SERVICE.
SCENARIO 2A: RETAIN METAPAN - SAN SALVADOR SERVICE THROUGH EXISTING ROUTE
SCENARIO 2B: RETAIN METAPAN - SAN SALVADOR SERVICE THROUGH AN APOPA CONNECTION.
SCENARIO 3B: RETAIN ACAJUTLA - SAN SALVADOR AND METAPAN - SAN SALVADOR SERVICES THROUGH AN APOPA CONNECTION
SCENARIO 3C: RETAIN ACAJUTLA - SAN SALVADOR AND METAPAN - SAN SALVADOR SERVICES THROUGH A SANTA ANA CONNECTIO
SCENARIO 5: FULL CLOSURE OF THE RAILROAD SYSTEM.

SOURCE: FREDERIC. R. HARRIS, INC.

Given the level of dependency on these two potential rail users, some level of commitment to make use of rail services would be required before going ahead with any investment in the railroad sector. This commitment would be most easily achieved if these two private enterprises participate in some capacity in the investments. However, as noted in Chapter 8, there appears to be slim possibilities for private participation and funding for rail investments would need to be made mainly by the national treasury.

10.3.3 Port Subsector

Based on the analysis developed by the modal expert in Chapter 5, five projects were considered for financial analysis, which are:

- Installation of Gantry Cranes on Pier C in Acajutla.
- Specialized Container Terminal in Acajutla.
- Grain terminal in Acajutla.
- Reconstruction of Cutuco Pier.
- Specialized Container Terminal in Cutuco.

Charter 5 presents detailed description of the key elements considered in preparing the financial analyses for the aforementioned projects and Table 10.3.4 summarizes the resulting financial indicators.

The installation of gantry cranes on pier C in Acajutla prior to year 2000, the specialized terminal for containers in Acajutla to start operations in 2005, the terminal for cereals in bulk in Acajutla to start operating on 2010, and reconstruction of the Cutuco pier for immediate operation, are evaluated under Scenario 1. This Scenario assumes that the road transportation system will expand with investments already programmed and any others that may be required to correct its restrictions, i.e. all investments required to facilitate traffic around San Salvador will be made and obstacles to port cargo originating in the eastern portion of El salvador will be eliminated.

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TABLE 10.3.4
Recommended Port Subsector Projects and Financial Indicators
(Monetary Values in 1994 Million Colones)

PROJECT	SCENARIOS	BEGGING OPERATIONS	NET PRESENT VALUE
GRANTY CRANES IN PIER "C"ACAJUTLA	1 AND 2	2000	624.73
SPECIALIZED CONTAINER TERMINAL ACAJUTLA	1 AND 2	2005 (2)	301.05
GRAIN TERMINAL ACAJUTLA	1	2010	N.A.
RECONSTRUCTION OF CUTUCO PIER	1 AND 2	2000	74.45
SPECIALIZED CONTAINER TERMINAL CUTUCO	2	2010	909.26

Source: Frederic R. Harris, Inc.

(1) Scenarios indicated for which investments are recommended (1- with additional highway improvements, 2- only including Committed investments)
(2) Begin operations in 2010 in Scenario 2 .
(Chapter 5).

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The construction of a specialized container terminal in Cutuco is evaluated under Scenario 2. This Scenario assumes all port investment costs as Scenario 1, except the specialized container terminal in Acajutla. In addition, this scenario considers that container traffic to Acajutla is limited to the volume that can be handled by Pier C (around 500,000 tons a year) and that the land transportation system will receive the investments already programmed, but that the obstacle to the traffic from the eastern portion of the country to Acajutla created by the congestion in San Salvador will not be solved.

10 3 4 Airport Subsector

Based on the analysis developed by the modal expert in Chapter 6, four scenarios were considered for financial analysis, which are:

- Scenario 1 - Existing air cargo volume.
- Scenario 2 - Air cargo growth without diversification
- Scenario 3 - Air cargo growth and diversification in Salvadorean cargo.
- Scenario 4 - Air cargo growth in both Salvadorean and regional demand.

Chapter 6 presents a detailed description of the key elements considered in preparing the financial analyses for the aforementioned scenarios and Table 10.3.5 summarizes the resulting financial indicators.

Revenues include projected revenues of import, export and transit cargo for each scenario. Costs include the proposed information system and warehouse expansion (when applicable) and operating costs.

Based on the results presented in Table 10.3.5 and Chapter 6, the following conclusions are drawn:

- Overall financial performance: All the scenarios show positive net cash flows at a 12% annual discount rate. Therefore, even if no increase in air cargo traffic is attained, and with the proposed tariffs, the air cargo services would provide financial benefits to AIES. With increased air cargo movement, particularly import cargo, as predicated in Scenarios 2 through 4, financial benefits increase substantially.
- feasibility of funds for investments: Based on the proposed tariffs and revenues and costs estimates, air cargo services generate enough funds in all scenarios to cover any operating and investments fund needs.

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TABLE 10.3.5

FINANCIAL INDICATORS OF AIRPORT SUBSECTOR SCENARIOS

(MONETARY VALUES IN 1994 MILLION COLONES)

SCENARIO	BEGGINING YEAR	PRESENT VALUE OF REVENUES	PRESENT VALUE OF COSTS	NET PRESENT VALUE	REVENUES TO COSTS RATIO
SCENARIO 1		121.90	105.31	16.59	1.16
SCENARIO 2	2014	226.79	137.04	89.75	1.65
SCENARIO 3	2009	282.29	152.10	130.19	1.86
SCENARIO 4	2009	282.63	154.83	127.80	1.83

SCENARIO 1 - EXISTING AIR CARGO VOLUME.
SCENARIO 2 - AIR CARGO GROWTH WITHOUT DIVERSIFICATION.
SCENARIO 3 - AIR CARGO GROWTH AND DIVERSIFICATION IN SALVADOREAN CARGO.
SCENARIO 4 - AIR CARGO GROWTH IN BOTH SALVADOREAN AND REGIONAL DEMAND.

SOURCE: FREDERIC R. HARRIS, INC.

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investment needs AIES should go ahead and introduce the required operational, information systems, and tariff structure changes to improve cargo flow and minimize on airport cargo storage time These improvements will delay facility investments to future years Only if Scenario 1 - No Air Cargo Traffic Growth is most likely to occur then operational improvements and investments are not required.

- Tariffs: As proposed in Chapter 8, there is a need for an overall review and update of air cargo tariffs:

  - Revise and update cargo handling charges to a graduated scale of fees to encourage consignees to pick up their cargo quickly.

  - Review and update cargo space rental fee to cover the costs of facility construction, maintenance, and operation.

  - Consider levying a per-kilo charge on export and transit cargo commensurate with handling costs, infrastructure use and impact.

10.4 Pre-Investment Programs

In this section, the Consultant briefly describes proposed studies identify by the specialists and discussed in each chapter as well as those identified as a result of the investment evaluation process.

They consist of and are discussed in the following sequence:

- **Additional interurban and urban demand analysis and technical assistance for sector planning.**

- **Environmental, feasibility and design work for the proposed investment in each transport subsector.**

10.4.1 Sector Demand Analysis and Planning

As discussed in Chapters 1 and 2, the Consultant proposes that GOES sector planning capabilities be improved by undertaking:

- Transport sector demand analysis based upon traffic studies described in chapter 2, analyzing and integrating traffic counts, weighing station data, port manifest analysis, urban traffic analysis, origin-destination surveys and customs data. This analysis can best be carried out by the proposed General Planning Directorate of the MOP with the appropriate technical assistance.

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- TRANUS Model applications and development can be achieved in three phases:

  - Train professionals of the various agencies concerned with transportation planning.

  - Apply of the model to key outstanding transport issues with assistance from specialists.

  - Improve and extend the existing model, especially by introducing urban traffic analysis, but also including further review of transportation costs, incorporation of improved demand data, and detailing of port, maritime, airport and air transport components.

- Technical assistance to the proposed General Planning Directorate of the MOP in transportation planning, including training in other planning techniques, thus accelerating GOES efforts to strengthen its sector planning and management capabilities.

10.4.2 Highway Subsector

In addition to the MOP modernization program with IDB support, as well studies and designs to implement projects with committed funds, the Consultant recommends the following pre-investment work for 1) improved highway maintenance and 2) planning of the proposed additional highway programs.

a. Enhanced Highway Maintenance Capacity

Technical assistance is needed to develop skills in maintenance management in three areas: promoting and contracting with microenterprises for routine maintenance, decentralization of maintenance capacity and responsibilities, and the design and management of concession contracts. All three can have significant impacts upon the efficiency of highway maintenance and operations. These are described below:

- *Microenterprise Promotion and Contracting*

  Chapter 3 proposes that the DGC promote the establishment of microenterprises by departing employees to contract for pluri-annual routine maintenance. Technical assistance can be contracted to promote this alternative among leaving employees and train potential managers in administrative skills, detailing supervision contracting procedures, as well as preparing DGC staff to manage this new type of program.

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include environmental analysis, field reconnaissance, determinationoftechnical feasibility, identification of constraints, detailed definition, preliminary analysis and costing of alternative alignments, and selection of one or two alternatives. The second-phase full feasibility studies of the retained bypass alternatives should include soil studies, detailed traffic and alignment analysis, selection of alignment and design standards, including economic criteria, and preliminary design.

- *Eastern CA-1 Highway*

  In about 1999, begin to review traffic growth on the Eastern Panamerican Highway (CA-1) and access roads to determine whether the services they will be providing will adequately service future demand. Many of the CA-1 links and access roads show levels of service B in 2015. It is entirely possible that actual traffic growth could be greater than projected, thus meriting initial plans for subsequent expansion. The future importance of the Port of Cutuco and industrial development around it will have a significant future impact upon traffic projections.

  This review should cover links between San Martin and San Miguel; San Miguel-Goascorán (El Amatillo); Junction with San Vicente-Tecoluca and possible construction of a new link shortening connection to CA-2 at El Playón; and Villa El Triunfo-Usulután.

- *Northern East - West Highway*

  Undertake a regional development study of the northern portion of El Salvador at the time major investments are being considered for this area. This should include or coincide with a feasibility and environmental impact study of the Northern East-West Highway and its access roads, as well as planning studies of complementary investments. This Study's results indicate the need for this approach, as this program, without additional investments in other development programs, is quite likely not to be feasible, at least for most of its links.

  The TRANUS model's location module not used in this study could be applied to evaluate this highway in the context of a regional development program.

For each of the highway sections, the environmental analysis proposed should be according to that specified in chapter 9.

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10.4.3 Rail Subsector

In the event the GOES does not take a decision to rehabilitate the railways or close FENADESAL based upon the results of this study, the Consultant recommends a final review of the key issues discussed above. This review can be completed in two to three months

10.4.4 Port Subsector

Once GOES makes the decision to proceed with the port privatization process, resources should be committed to the following:

a. Acajutla Master Plan

A master plan, preferably by a relatively independent Acajutla Port Authority. This could include physical planning and traffic analysis as well as the technical and financial analysis required to allow for the preparation of concession bid documents. It should include the planning and scheduling of the proposed investments, including the container facilities and the grain terminal. The latter should be discussed with the interested parties. Once there is general agreement on how to proceed and how the organizations involved will share responsabilities for the facility, a feasibility study should be carried out, including considerations for alternate technologies. Documents would then be prepared for concession bids including financial, regulatory and design specifications to the extent required for these documents.

b. Training

Training of the port labor sector regarding the benefits which can be achieved with a dynamic, progressive and growing port where there are incentives for more productive operations. Training of CEPA professional staff in preparation for their new roles in the management of the port sector.

Pre-investment work for Cutuco includes:

c. Cutuco Pier Rehabilitation Design

The GOES should immediately transfer the facility to CEPA for it to take on full responsibility for the design and implementation of its rehabilitation.

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d. The Cutuco Container Terminal Feasibility Study

This study is scheduled to begin shortly. Ideally, it should include:

- The possible development of port-related industrial parks and free zones
- The port's development impact
- Potential demand at this facility to service Honduras, other Central America countries, and trans-istmic traffic
- The most effective management and marketing framework, preferable integrating the existing pier and the new facility within a relatively independent Cutuco port authority.

The Consultant considers that this should be analyzed as a dedicated container facility keeping non-containerized cargo at the present pier. However, alternative facility scenarios could be considered.

Once this study is completed and the plans for Acajutla's Pier C are implemented, the following additional study may be needed:

e. Container Services Program

The appropriate construction program for the specialized container terminals should be analyzed further including coordination among container-related investments and the demand for maritime services. A program may be required to achieve at Acajutla and Cutuco 1) optimum use of total capacity, an operational and financial objective, as well as 2) the efficient use of the entire intermodal network, thus benefitting the sector's overall economy. This review should also consider the interaction of these investment programs with maritime operations, the opinions and potential commitments of interested shipping companies. Feeder services between Cutuco and Acajutla, using barges or similar vessels, may be an alternative. This study would be needed once the proposed facility at Cutuco is fully defined regarding capacity, facilities and financing. It could also include a review intermodal facility needs.

10.4.5 Airport Subsector

The Consultant recommends carrying out a Master Plan for the El Salvador International Airport. Based on the review of past and current airport planning and development work, the Consultant recommends that a master plan update be prepared including:

- Inventory of existing airport infrastructure facilities and ongoing expansion projects.

- Plan and design the development of airport infrastructure, based on identified operational and demand parameters.

- Prepare influence area development and regulatory plan to establish orderly growth.

- Define budgets and investment programs for each of the developing plans and establish their priorities.

- Carry out financial and economic evaluation of the development plans in consideration.

Specifically with regard to cargo terminal needs, the master plan should include concession plans and documents required for letting one or more cargo terminal concessions. Also, the systems to manage cargo flow and terminal use.

10.4.6 Interurban Transport Policies and Services

The Consultant recommends the following pre-investment activities in public transportation, detailed in Chapter 7:

- Technical assistance in the organization of a management information system or data base, and its use in re-engineering regulation implementation procedures.

- An analysis of the supply of bus services, passenger demand and their balance, the need for increases in services and simplification of the existing route system.

- A national bus terminal concession plan, estimated in Chapter 7 as approximately 10 terminals, 3 in San Salvador and 7 in other cities. This would guide the GOES, bus associations and interested investors in determining needs, concession procedures and preliminary costs.

10.4.7 Summary of Proposed Pre-Investments

A summary of the proposed pre-investments is presented in Table 10.4.1. The estimated dates are based upon studies currently underway or planned, tentative construction schedules and the sequencing of pre-investment work. The estimated costs are only at the level of order of magnitude. Actual amounts can be estimated more accurately after preparing detailed scopes of work.

Table 10.4.1
Transport Sector Pre-Investment Program
(Costs in Million 1994 Colones)

Subsector and Program	Pre-Investment Type	Proposed Year	Estimated Cost
Transport Sector Programs Transport Sector Demand Analysis	Studies/ Technical Assistance	1996	7
Model Applications and Development	Training and Technical Assistance	1996	4
Sector Planning	Technical Assistance	1997	10
Highway Programs Enhanced Highway Maintenance Capacity	Study and Tech Ass.	1996	15
Northern Bypass	Feasibility study	2002-2003	8
Southern Bypass	Feasibility study	2003-2004	4
Eastern Panamerican Highway	Traffic analysis	1999	0.5
Northern East-West Highway	Regional development and highway feasibility	2005	7
Rail Program Final rail review, if required	Study	1996	1
Rehabilitation plan/design (1)	Design	1996	20
Port Programs Acajutla Master Plan	Master Plan/ concessions	1996 - 1997	8
Port labor sector training / CEPA professional staff training	Training	1996	4
Cutuco Container Terminal	Feasibility Study	1996	4
Container services program	Strategic action plan	1997	3
Cutuco pier rehabilitation design	Design/action plan	1996	4
Airport Program International Airport Master Plan	Master plan/ concessions	1996	5
Interurban Transport Programs Public Transit MIS and Supply -Demand Balance	Tech. Ass. and Studies	1997	4
Bus Terminal Concession Plan	Study	1997	2
TOTAL			110.5

Source: Frederic R. Harris, Inc.
(1) If the decision to is rehabilitate

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10.5 Conclusions and Recommendations

Based on preliminary estimates of economic and financial feasibility, the Consultant concludes that there are needs for

a Transport Sector

- A total of 11 investment programs, covering all modes, were evaluated with a total cost of more than 12 billion colones of which over 80% are for highways.

- The development of sector planning capacity as part of the activities of a new General Directorate of Planning of the Ministry of Public Works, improve El Salvador's urban, interurban and transport sector demand data base, as well as provide staff training and technical assistance in transportation planning and modeling.

b. Highways

- Enhanced highway maintenance capacity to be archeved through technical assistance to 1) promote and contract microenterprises for routine maintenance, 2) plan and implement maintenance decentralization and 3) evaluate and plan highway concessions.

- Two urban bypasses around San Salvador are needed. The Consultant recommends their study between 2002 and 2004 for completion largely by about 2010. Given the significant highway improvements underway and committed, these are the only capacity constraints identified through the year 2015 .

- The Northern East-West Highway, a penetration road to develop the country's least developed region. It was analyzed and, as expected, was not found feasible as a complete program, when only considering transport cost savings. The Consultant recommends a regional development study around 2005.

- Future constraints on much of the East CA-1 Highway will not require further investments before 2015, but B levels of service are expected based upon projected traffic. The Consultant recommends that traffic be monitored for improvement needs beginning in approximately 1999.

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c. Rail

The complete closure of FENADESAL has the highest financial return of the scenarios evaluated It is unlikely that economic benefits, largely due to reduced highway congestion, will be sufficient to warrant rehabilitation Recent construction of competing roads play an important role in this conclusion.

The Consultant recommends closure unless several conditions can be met. If need be, a final review could be completed within 3 months.

d. Ports

Based upon the financial and economic analysis of this study, the Consultant concludes that investments in all five facilities analyzed would be financially feasible as follows:

Under the road scenario, without a barrier around San Salvador, the proposed gantry cranes on Acajutla's Pier C and subsequent construction of Pier D to provide container service are feasible. This is also true for a future grain terminal there and Cutuco pier rehabilitation. In this scenario, the Cutuco Container Terminal is not feasible based upon projected Salvadorean cargo.

Under the trend scenario, with the San Salvador barrier remaining in place, the above feasible projects remain so and the Cutuco Container Terminal comes closer to feasibity, especially as containers from/to the Atlantic, Central American and dry canal traffic become significant.

The Consultant recommends preparing the labor sector and CEPA for port privatization through training on how to adjust to it and enhance its positive impacts.

The Consultant recommends:

- CEPA immediately take over and rehabilitate the Cutuco Pier.
- After the first gantry crane is installed on Acajutla Pier C, market and monitor this new container service.
- Review Cutuco Container terminal feasibility study.
- Review actual container flows to Acajutla, Quetzal, Santo Tomás and Puerto Cortes from/to Atlantic and Pacific ports.

- Decide when to build container terminals at Acajutla (Pier D) and/or Cutuco Within the analytical limits of this study, only the former is recommended. The Consultant proposes specific tasks to be carried out as part of the feasibility study scheduled to begin in 1995

e. Airports

Given the lack of a master plan to guide future construction at the International Airport and current cargo terminal constraints, the Consultant recommends:

- Implement a master plan covering the general areas specified including concession policies.

- Design and implement a computerized cargo management system integrated with customs and shipper information systems, provide incentives for more efficient warehouse use and extend work hours.

- These measures make it possible to postpone terminal expansion.

- Implement terminal expansion by about 2005, according to master plan and demand growth.

f. Interurban Transport

Among the many recommendations specified for this subsector, the Consultant recommends:

- Technical assistance in the developing and implementing an MIS system, and using it to re-engineer regulation procedures.

- Analyze the bus supply-passenger demand balance.

- Prepare a national bus terminal concession plan.

ANNEX 10.2.1

ECONOMIC METHODOLOGY

ANNEX 10.2.2

RESULTS OF THE ECONOMIC ANALYSIS

- La vida útil del programa.

Fueron calculados dos indicadores de factibilidad económica, la tasa interna de retorno y el valor presente neto a tasa de descuento de 12%.

Las salidas de las hojas eletrónicas para cada programa se encuentran en el anexo siguiente.

3.3 Materiales Nacionales

El factor de conversión, para los materiales nacionales, solamente se la ha deducido el impuesto al valor agregado (IVA), del costo en bien ajustado por el factor de conversión estándard

FCMN = (1-0.10)x0.9744 = 0.8769

3.4 Materiales Extranjeros

Para estimar este factor, se partió del cambio promedio prevaleciente durante 1992, siendo el tipo de cambio de 8.72

$$TCC = \frac{TCO\ (Promedio)}{FCE} = \frac{8.72}{0.9744} = 8.94$$

Utilizando la siguiente relación y sustituyendo valores:

$$FC = 1 - (TCC-TCO)xFCE$$

$$= (1 - (8.94 - 8.72)) \times 0.9744 = 0.760$$

4. Escenarios de Evaluación

Fueron definidos escenarios de evaluación para el análisis de los programas identificados. Se adjunta al final de este anexo el listado de los escenarios con sus descripciones. Los archivos de tramos del modelo para cada escenario se encuentra en la base de datos del proyecto a entregar a su final.

5. Indicadores de Evaluación Económica

Fueron insertados a una hoja eletrónica standar para la evaluación de cada programa:

- **Los beneficios computados por el modelo TRANUS por la comparación entre cada escenario alternativo y escenario base, para cada año de evaluación, como también el pronóstico de la tasa de crecimiento de los beneficios en períodos posteriores a 2015, cuando necesario.**

- **Los costos financieros de inversión y preinversión con su calendarización.**

- Los precios de cuenta y las proporciones que los materiales nacionales y extranjeros, y la mano de obra calificada y no calificada representan del costo total de cada programa.

3.2 Factor de Conversión de la Mano de Obra

3.2.1 Mano de Obra Calificada

La alta tasa de subutilización y desempleo existente en El Salvador afecta principalmente los niveles menos calificados de la fuerza de trabajo.

En función de lo anterior se considera el supuesto que el costo para el empleador de la mano de obra calificada reflejo razonable los costos directo de oportunidad a precios de mercados no obstante este precio es preciso de estandarizarlo a efecto de mayores irregularidades presentado en el mercado.

FCMOC (Factor de Conversión Mano de Obra Calificada)
= 1x0.9744 = 0.9744

3.2.2 Mano de Obra no Calificada

Para este caso, el costo directo de oportunidad se estimo de acuerdo con el patrón estacional global de empleo del sector agrícola, el cual fue comparado con un empleo alterno de otro sector y que correspondiera al mismo nivel de la categoría agrícola.

El costo de oportunidad, a precios de mercado, asociado en trabajador no calificado del sector agrícola, considerado en la época "no pico (9 meses) un salario de ¢ 200/mes, en actividades cuyos patrones no se fijan a la legislación de salario mínimo, particularmente, durante el año, fue calculado de la siguiente forma:

CDOpm = (3x488.07)+(9x200) = 3264.221
CDOpm = 272.01

Ahora:

$$\frac{CDOpm}{CPMAA} = x\ fce = \frac{272.01}{662.80} \times 0.9744 = 0.40\ CDOMpm$$

CPMAA = Costo a precios de mercado en actividades alternativo (Industria de la Construcción).

El factor de conversión de la mano de obra no calificada es 0.40

Para estimar la factibilidad económica de los programas evaluados, se aplicó la metodologia indicada por Helio Londero adoptada por la DGC. Se partió de la evaluación financiera, ajustando cada uno de los componentes comprendidos en los flujos de los costos y beneficios, utilizando para ello su respectivo factor sombra correspondiente mano de obra no calificada, la calificada, los materiales nacionales y los extranjeros.

A continuación se presenta el siguiente cuadro resúmen de los factores de ajuste correspondiente para cada componente.

Factores de Ajuste para la Evaluación Económica

Componente	Factor Sombra
Mano de Obra no Calificada	0.40
Mano de Obra Calificada	0.9744
Materiales Nacionales	0.8768
Materiales Extranjeros	0.760

Con el propósito de evitar las distorciones en los precios reflejados en el valor relativo de los precios, deberá ajustarse los costos de inversión, a fin de convertir estos precios del mercado nacional, a precio equivalente el cual resulta de derivarse con el factor de conversión standard, teniendo este su origen en la relación media entre el precio frontera y el de mercado.

3.1 Factor de Conversión Estándar

$$FCE = \frac{M + X}{(M+tm) + (x-tx)}$$

En donde:

FCE = Factor de Conversión Estándard.
M = Importaciones
x = Exportaciones
tm = Impuestos a las Importaciones
tx = Impuestos a las Exportaciones

Sustituyendo con valores para el año 1991 se tiene

$$FCE = \frac{11275.80 + 4715.80}{(112758+641.80) + (4715.80-221.7)} = \frac{5991.60}{16411.70} = 0.9744$$

La velocidad que se utiliza en una nueva iteración del modelo de transporte es el promedio de la obtenida en el proceso de restricción con las de la iteración anterior.

Si el operador es público, el tiempo de espera de los usuarios se incrementa en cada enlace por dos razones: la menor velocida de circulación de los vehiculos, que disminuye la frecuencia, y la relación $/h$ que es el nivel de saturación de las unidades vehiculares.

1.4 Convergencia

La convergencia del modelo de transporte se verifica en todos los enlaces por la diferencia porcentual entre una iteración y otra para dos variables: la velocidad de circulación de los operadores y el volumen total asignado. El proceso iterativo termina cuando la máxima diferencia en ambas variables está por debajo de un criterio de convergencia establecido, o cuando se alcanza el máximo de iteraciones prefijado.

2. El Modelo TRANUS - Evaluacion

Con el procedimiento de evaluación de TRANUS se estima el efecto de la aplicación de determinadas políticas (planes o proyectos) en el transcurso del tiempo, a partir de indicadores de beneficio socioeconómico.

El modelo contabiliza tanto los beneficios monetarios como los no-monetarios, representados, en su mayor parte, por los ahorros en tiempo, cuya valoración es discutible y ha sido objeto de múltiples investigaciones; pero en el modelo, hay consistencia entre los valores usados para simular las decisiones de los usuarios y los utilizados en la evaluación. Esta es la virtud de un sistema de evaluación integrado a la simulación: la consistencia entre variables, parámetros e hipótesis utilizadas en todo el proceso.

2.1 Procedimiento de Evaluación

Se evalua un programa por la comparación entre dos juegos de simulaciones, para calcular el excedente al consumidor como indicadores de beneficios a los usuarios del transporte. Generalmente se toma como base de comparación una estrategia base que no incluye el proyecto que se desea evaluar, y otra estrategia que sí lo incluye, denominadas *base* y *alternativa* respectivamente. El cálculo de beneficios se realiza para cada uno de los períodos de simulación que especifique el usuario. Con estos datos, se calculan los beneficios a los usuarios (excedente al consumidor) para cada período de tiempo y categoría de demanda. Se dispone de los detalles del cálculo para cada par origen - destino y los resultados se presentan en forma matricial. La suma de estas matrices respecto a los orígenes representa los beneficios totales por zona, de tal manera que es posible conocer a quiénes beneficia un proyecto y en que zonas.

3. PRECIOS DE CUENTA, SOMBRA O DE EFICIENCIA

1.3 Restriccion de Capacidad

La relación demanda capacidad total en cada enlace se calcula dividiendo los vehiculos equivalentes que lo comparten entre la capacidad física, que es un dato.

$$DC_1 = \frac{VE_1}{Q_1}$$

donde:

VE= es vehiculos equivalentes
Q1= capacidad

También se presentan como resultado de la asignación, las velocidades y tiempos de espera de los operadores y el nivel de servicio en que funciona cada enlace, los cuales se calculan en el proceso de restricción de capacidad que se describe a continuación.

La velocidad de circulación de cada operador se ajusta de acuerdo al nivel de congestión de cada enlace de la red. En los enlaces que se hayan definido con capacidad infinita no se realiza este ajuste, por tanto, se mantiene constante la velocidad inicial de los operadores y un nivel de servicio A (a flujo libre) en todas las iteraciones del modelo de transporte.

La figura 1 muestra gráficamente la función para un operador cuya velocidad inicial es de 80 Km/hr, con dos alternativas.

Figura 1: Función de reducción de velocidad de los operadores

tc_o factor del costo de operación del operador o traspasado al usuario como tarifa.

Las tarifas que se definen en una aplicación, pueden tener uno o más de los componentes de la función. En algunos casos, el tranporte regional de carga establece su tarifa con un elemento fijo (mínimo) más un componente por distancia; en otros casos, cuando algunos recorridos incluyen vías muy congestionadas, prefieren utilizar el componente tiempo en lugar de la distancia. Por lo general, cuando la tarifa se define en función del costo de operación, se asigna exclusivamente al último término de la función, y el resto de los elementos se iguala a cero.

1.1.2 Costos de Operación

Los costos de operación son los incurridos por los operadores que prestan el servicio de transporte, y pueden o no formar parte de la tarifa. Se calculan por vehículo, y se pueden definir en cada aplicación, con los elementos siguientes:

$$c_o = f(cf_o, ct_o, cd_o),$$

donde:

cf_o **costo fijo de operación del operador o; generalmente referido a costos administrativos y a labores de carga y descarga en el transporte de mercancías.**

ct_o **costo en que incurre el operador o por unidad de tiempo; generalmente se se refiere al salario de los choferes.**

cd_o **costo de operación del operador o por unidad de distancia; se refiere al gasto por neumáticos, mantenimiento y consumo de energía.**

1.2 Desutilidades y Probabilidades

La desutilidad es una medida de accesibilidad que incide tanto en las decisiones de localización como en las de transporte. El costo monetario de viaje, en cambio, forma parte de la estructura de precios de los sectores en el modelo de uso del suelo. El modelo lleva cuenta separada del costo monetario y la desutilidad.

El costo generalizado en cada paso de cada modo se calcula simultáneamente en el proceso de búsqueda, como se explicó en la sección anterior. A partir de él, se calculan las desutilidades o costos impuestos, a nivel de modos y a nivel de zonas.

y los tiempos de espera por cada operador.

De cada opción de viaje que presenta la oferta, el usuario percibe una desutilidad, la cual está compuesta por el costo monetario del viaje, por la valoración del tiempo de viaje y de espera, y por elementos subjetivos como grado de confort, confiabilidad, seguridad, etc.

1.1 Estructura de Costos

En la estimación de la demanda y su asignación a la oferta intervienen dos tipos de costos:

- Costos al usuario, en los cuales hay componentes monetarios y no monetarios, por lo que se denominan *costos generalizados*; se miden por unidad transportada.

- Costos de operación, estrictamente monetarios; se contabilizan por vehículo.

1.1.1 Costo monetario al usuario

El componente monetario del costo al usuario es la tarifa, y puede ser de dos tipos: dependiente o independiente de los costos de operación. El transporte público suele cobrar tarifas que no tienen correspondencia alguna con el costo de operación de las unidades. En cambio, el transporte de carga suele cobrar al usuario una tarifa que cubra sus costos de operación más una ganancia. En el caso del transporte particular, el usuario es el mismo operador, por tanto su costo monetario de viaje está en función del costo de operación del atumóvil.

El término *tárifa* se utiliza en forma general para referirse al costo monetario al usuario, aunque dicho término no sea adecuado al caso del auto particular. El modelo proporciona los siguientes elementos para definir las tarifas en cada aplicación:

$$t_o = f(tf_o, tt_o, td_o, tc_o),$$

donde:

tf_o tarifa fija que cobra el operador o al abordar; si se han definido operadores con tarifa integrada, tf corresponde a lo que el operador o cobra a los pasajeros que provienen del operador anterior.

tt_o tarifa por unidad de tiempo que cobra el operador o

td_o tarifa por unidad de distancia que cobra el operador o

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El Estudio ha adoptado los conceptos económicos utilizados por el modelo TRANUS. La metodología del modelo está descrita en anexo del Capítulo 2. Se presentan aquí los aspectos más específicos en cuanto a evaluación económica.

Además, se ha revisado la metodología aplicada por la Dirección General de Caminos en cuanto al cálculo de precios de cuenta o económicos, la cual ha sido adoptada por el Estudio para permitir su comparación con estudios anteriores. La actualización de los precios de cuenta no tendría mayor impacto sobre los resultados obtenidos, a pesar que varía el precio de cuenta de materiales extranjeros.

1. El Modelo TRANUS - Transporte

Como resultado de las proyecciones de demanda de transporte, exógenos al modelo, presentados en el Capítulo 2, se obtuvo un conjunto de matrices de flujos de demanda entre zonas de tráfico, las cuales fueron convertidas en flujos de demanda de transporte.

La primera tarea del modelo de transporte es la búsqueda de los *pasos* que conectan cada par origen-destino por cada *modo de transporte*. Los modos, a su vez, pueden estar constituidos por varios *operadores de transporte*;

El modelo construye los pasos a partir de la *red de transporte*, definida por un grafo direccionado en el cual cada enlace tiene asignado un conjunto de características: tipo de vía, distancia, capacidad, rutas de transporte público y giros prohibidos. A su vez cada tipo de vía tiene un *administrador* que se encarga de su mantenimiento, y una serie de atributos comunes para cada operador que puede utilizarlo: velocidad, cargos (peajes, estacionamientos) costo de operación y vehículos equivalentes. El siguiente proceso en la secuencia de cálculo es la distribución de los viajes generados entre los distintos modos de transporte.

La demanda por modos se asigna a la red de transporte con un modelo logit multinomial. La asignación incluye además los vehículos que retornan vacíos. Estos se calculan mediante un parámetro de *consolidación* que controla la proporción de vehículos que puede atraer carga en su viaje de retorno, dependiendo de la demanda en sentido inverso al viaje original.

De acuerdo a las *tasas de ocupación vehicular*, los viajes asignados a los pasos implican un determinado número de vehículos de cada operador en la red. Con el fin de evaluar el nivel de congestión en los distinto enlaces, se utilizan factores de equivalencia por operador y tipo de vía para calcular el volumen total de tráfico en *vehículos equivalentes* que es la unidad en que se mide.

La última etapa del proceso interactivo es la restricción de capacidad, en el cual se mide el efecto de la congestión y se afectan, en consecuencia, las velocidades de circulación

Se presentan aquí las salidas de la hoja electrónica de los proyectos de inversión evaluados, cuales sean

EVL-CIRN.WK4	Evaluación de la Circunvalación Norte (Escenario D) con el Escenario Tendencial con congestión urbana ajustada (L)
EVD-CIRS WK4	Evaluación de la Circunvalación Sur (Escenario K) con el Escenario D (Tendencial con Circunvalación Norte)
EVE-LONN.WK4	Evaluación de la Longitudinal del Norte (Escenario E) con el Escenario K (Escenario Circ. Sur)
EVI-EF1.WK4	Evaluación del Escenario 1 de Rehabilitación Férrea (Acajutla-San Salvador - Escenario I) con el Escenario E
EVI-EF2A.WK4	Evaluación del Escenario 2 de Rehabilitación Férrea con conexión en Apopa (Escenario I) con el Escenario E
EVI-EF3A.WK4	Evaluación del Escenario 3 de Rehabilitación Férrea con conexión en Apopa (Escenario Q) con el Escenario E (Vial)
EVI-EFER.WK4	Evaluación del Escenario 3 de Rehabilitación Férrea con conexión en Santa Ana (Escenario I) con el Escenario E
PROCONTF-WK4	Pronóstico de la Carga Marginal (adicional) de Contenedores que sería atraído por cada Muelle adicional
EVE-MUEC.WK4	Evaluación del Muelle C de Acajutla (Escenario E Vial) con el Escenario U (sin contenedores en Acajutla)
EVE-TCAC.WK4	Evaluación del Muelle D de Acajutla (Escenario E Vial) con el Escenario U (sin contenedores en Acajutla), con Cutuco
	Evaluación del Terminal de Granos en Acajutla en base al análisis de beneficios y costos del especialista
EVE-JCUT.WK4	Evaluación de la Rehabilitación del Muelle de Cutuco, del Escenario E (vial) con Escenario J (sin el Muelle)
EVC-TCU2.WK4	Evaluación de la Terminal de Cutuco (Escenario H, con Terminal de Cutuco) con Escenario C (Intermodal)
EVE-TCU2.WK4	Evaluación de la Terminal de Cutuco (Escenario H, con Terminal de Cutuco) con Escenario E (Vial)

CIRCUNVALACION NORTE - ALTERNATIVA 1

EVL-CIRN WK4

ESCENARIO D (CIRC. N) COMPARADO CON L (BASE)

Interseccion CA8 - Sitio del Nino - Apopa, Calle a Tonacatepeque - Cojutepeque (CA-1 Nueva), Conector Ilopango (2010), Apopa - San Martin (2015)

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	2010 PRECIOS MERCADO	2010 PRECIOS ECONOMICOS	2015 PRECIOS MERCADO	2015 PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	733	600	270	221
COSTOS DE MANTENIMIENTO	7.66	6.28	0.66	0.54
COSTOS ESTIMADOS PREINVERSION	9.43	9.19	1.78	1.73
BENEFICIOS EN CTS. OPERACION - 2010	391	256	1,052	687
BENEFICIOS EN AHORRO EN PUERTO	0	0		0
BENEFICIOS TOTALES	391	256	5,286	3.452

MODELO DE INDICADORES DE EVALUACION ECONOMICA

CIRCUNVALACION NORTE - ALTERNATIVA 1

ESCENARIO D (CIRC. N) COMPARADO CON L (BASE)

	2010	2015	2035
BENEFICIOS ECONOMICOS	1,540 (1)		
COSTOS ECONOMICOS DE INVERSION	600	221	
COSTOS ECONOMICOS PREINVERSION	9	2	
TASA DE DESCUENTO	12.00%		
TASA DE CRECIMIENTO DE LA DEMANDA	21.86%	5.53% (2)	
AÑOS DE CONSTRUCCION	3	3	
PERIODO DE EVALUACION	23	23	
AÑOS DE BENEFICIOS DEL PROYECTO	20	20	
VIDA UTIL DEL PROYECTO	20	20	

124 VP (COSTOS)	1 135
VP(BENEFICIOS)	5.709
VPN	4 574
TIR	33.08%

(1) Beneficios 2030

(2) tasa crecimiento demanda 2015-35

CIRCUNVALACION SUR - Alternativa 3
ESCENARIO K (CIRC. S) COMPARADO CON D (BASE, INCLUYENDO CIRC. N) - S/ CONG. URBANA
La Cuchilla-Sta.Tecla-Desvio La Libertad-S.Marcos, S.Tomas-Ilopango (2010)
[Calle Tonacatepeque - Cojutepeque (CA-1 Nueva) y Conector Ilopango incluidos en la Circ. Norte]

EVD-CIRS.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	516.51	423
COSTOS DE MANTENIMIENTO	3.53	2.89
COSTOS ESTIMADOS PREINVERSION	3.85	3.75
BENEFICIOS EN CTS. OPERACION - 2010	539	352
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	539	352

MODELO DE INDICADORES DE EVALUACION ECONOMICA

CIRCUNVALACION SUR - Alternativa 3
ESCENARIO K (CIRC. S) COMPARADO CON D (BASE, INCLUYENDO CIRC. N) - S/ CONG. URBANA

BENEFICIOS ECONOMICOS - AÑO FINAL	2,467		VP (COSTOS)	681
COSTOS ECONOMICOS DE INVERSION	423		VP(BENEFICIOS)	7,902
COSTOS ECONOMICOS PREINVERSION	4		VPN	7,222
TASA DE DESCUENTO	12.00%	De 2015 en delante a:	TIR	43.33%
TASA DE CRECIMIENTO DE LA DEMANDA	21.11%	6.82%		
AÑOS DE CONSTRUCCION	5			

LONGITUDINAL NORTE

EVE-LONN.WK4

ESCENARIO E (LONG. N) COMPARADO CON K (BASE) - s/cong. urb.

Metapan-Chalatenango, SnFrancisco Gotera - km 18 (2010), Chalatenango-Osicala-Sn Francisco Gotera (2015), Sensuntepeque-Des. San Vicente (2015)

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	2010 PRECIOS MERCADO	2010 PRECIOS ECONOMICOS	2015 PRECIOS MERCADO	2015 PRECIOS ECONOMICOS	TOTAL PRECIOS MERCADO	TOTAL PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	659	540	2,093	1,714	2,752	2,254
COSTOS DE MANTENIMIENTO	4	3	7	4	10	7
COSTOS ESTIMADOS PREINVERSION	4	4	11	10	15	14
BENEFICIOS EN CTS. OPERACION - 2010/15	48	31	262	171	310	203
BENEFICIOS EN AHORRO EN PUERTO	0	0	0	0	0	0
BENEFICIOS TOTALES	48	31	262	171	310	203

benef. de inv. de 2015

MODELO DE INDICADORES DE EVALUACION ECONOMICA

LONGITUDINAL NORTE

ESCENARIO E (LONG. N) COMPARADO CON K (BASE) - s/cong. urb.

	2010	2015	TOTAL		
BENEFICIOS ECONOMICOS - AÑO FINAL	83	347		VP (COSTOS)	5,934
COSTOS ECONOMICOS DE INVERSION	540	1,714		VP(BENEFICIOS)	1,798
COSTOS ECONOMICOS PREINVERSION	4	11		VPN	(4,135)
TASA DE DESCUENTO	12.00%	12.00%		TIR	4.76%
TASA DE CRECIMIENTO DE LA DEMANDA(1)	5.00%	5.00%			
AÑOS DE CONSTRUCCION	3	3			
PERIODO DE EVALUACION	23	23			
AÑOS DE BENEFICIOS DEL PROYECTO	20	20			
VIDA UTIL DEL PROYECTO	20	20			

(1) - 2005, 2005-2015, 2015 - 2015-2035.

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PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 1
ESCENARIO I (Alternativa) CON E (Base)
Rehabilitación Acajutla - San Salvador,
Construcción de la Conexión a la Planta en Nejapa (2005)

EVI-EF1.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	71	55
COSTOS DE MANTENIMIENTO	9	7
COSTOS ESTIMADOS PREINVERSION	7	7
BENEFICIOS EN CTS. OPERACION - 2005	2	2
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	2	2

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 1
ESCENARIO I (Alternativa) CON E (Base)

	2005-2015	2015-2035
BENEFICIOS ECONOMICOS ULTIMO AÑO	2	5
COSTOS ECONOMICOS DE INVERSION	55	
COSTOS ECONOMICOS PREINVERSION	7	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	1.21%	5.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	214
VP(BENEFICIOS)	18
VPN	(196)
TIR	-8.85%

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 2a - Via Apopa

EVI-EF2A.WK4

ESCENARIO I (Alternativa) CON E (Base)
Rehabilitacion San Salvador - Apopa - Metapán,
Construccion de la Conexión en Apopa (2005)

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	81	63
COSTOS DE MANTENIMIENTO	11	9
COSTOS ESTIMADOS PREINVERSION	8	8
BENEFICIOS EN OTS OPERACION - 2005	13	9
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	13	9

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 2a - Via Apopa
ESCENARIO I (Alternativa) CON E (Base)

	2005-2015	2015-2035
BENEFICIOS ECONOMICOS ULTIMO AÑO	10	26
COSTOS ECONOMICOS DE INVERSION	63	
COSTOS ECONOMICOS PREINVERSION	8	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	1.21%	5.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	168
VP(BENEFICIOS)	94
VPN	(75)
TIR	5.31%

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 3a - Via Apopa
ESCENARIO Q (Alternativa) CON M (Base)
Rehabilitación Acajutla - San Salvador, San Salvador - Metapán,
Construcción de la Conexión en Apopa y a la Planta en Nejapa (2005)

EVI-EF3A.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	148	116
COSTOS DE MANTENIMIENTO	19	15
COSTOS ESTIMADOS PREINVERSION	15	14
BENEFICIOS EN CTS. OPERACION - 2005	25	16
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	25	16

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 3a - Via Apopa
ESCENARIO Q (Alternativa) CON M (Base)

	2005-2015	2015-2035
BENEFICIOS ECONOMICOS ULTIMO AÑO	18	49
COSTOS ECONOMICOS DE INVERSION	116	
COSTOS ECONOMICOS PREINVERSION	14	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	1.21%	5.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	312
VP(BENEFICIOS)	178
VPN	(134)
TIR	6.25%

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 3 - Via Santa Ana EVI-EFER.WK4
ESCENARIO I (Alternativa) CON E (Base) - S/Cong. urb.
Rehabilitación Acajutla - San Salvador, Sitio del Niño - Santa Ana - Metapán,
Construcción de la Conexión en Santa Ana y a la Planta en Nejapa (2005)
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TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	192	119
COSTOS DE MANTENIMIENTO	19	15
COSTOS ESTIMADOS PREINVERSION	19	19
BENEFICIOS EN CTS. OPERACION - 2005	25	16
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	25	16

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: REHABILITACION DE LA RED FERREA - ESCENARIO 3 - Via Santa Ana
ESCENARIO I (Alternativa) CON E (Base) - S/Cong. urb.

	2005-2015	2015-2035
BENEFICIOS ECONOMICOS ULTIMO AÑO	18	49
COSTOS ECONOMICOS DE INVERSION	119	
COSTOS ECONOMICOS PREINVERSION	19	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	1.21%	5.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	322
VP(BENEFICIOS)	178
VPN	(144)
TIR	6.15%

5

ACAJUTLA

PRONOSTICO DE CARGA MARGINAL EN CONTENEDORES POR MUELLE (1)

EN MILES DE TONELADAS

PROCONTF.WK4

	1992	1999	2000	2001	2002	2003	2004	2005	2010	2015
FLUJO EXISTENTE MUELLE B?	283	372.4087	372.4087	372.4087	372.4087	372.4087	372.4087	372.4087	372.4087	372.4087
MUELLE C	0		161.5913	194.5913	228.5913	261.5913	327.5913	127.5913	127.5913	127.5913
MUELLE "D"	0							275	705	1407
TOTAL	283	372.4087	534	567	601	634	700	775	1205	1907
PROPORCION										
FLUJO EXISTENTE MUELLE B?	1	1	0.697395	0.656805	0.619648	0.587395	0.532012	0.480527	0.309053	0.195285
MUELLE C	0	0	0.302605	0.343195	0.380352	0.412605	0.467988	0.164634	0.105885	0.066907
MUELLE "D"	0	0	0	0	0	0	0	0.354839	0.585062	0.737808
TOTAL	0	1	1	1	1	1	1	1	1	1
Beneficios en millones										
FLUJO EXISTENTE MUELLE B?			0	0	0	0	0	942.045	862.0504	834.4376
MUELLE C			0	0	0	0	0	322.755	295.3479	285.8875
MUELLE "D"			0	0	0	0	0	695.64	1631.932	3152.595
TOTAL			545.7806	618.9873	686.004	744.1756	844.0646	1960.44	2789.33	4272.92

(1) Son los flujos adicionales que cada muelle atendería.

PROYECTO: MUELLE "C" - ACAJUTLA

EVE-MUEC.WK4

ESCENARIO E (VIAL) COMPARADO CON U (S/CONT. EN ACAJUTLA)

Proporción de los contenedores adicionales atendidos por el muelle x beneficios de atender contenedores en Acajutla

Se supone que la Terminal de Contenedores en Cutuco sea establecida.

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	2000 PRECIOS MERCADO	2000 PRECIOS ECONOMICOS	2005 PRECIOS MERCADO	2005 PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	179	138		
COSTOS DE MANTENIMIENTO	15	12		
COSTOS ESTIMADOS PREINVERSION	18	17		
BENEFICIOS EN CTS. OPERACION - 2000	43	28	34	22
BENEFICIOS EN AHORRO EN PUERTO	0	0		
BENEFICIOS TOTALES	43	28		

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: MUELLE "C" - ACAJUTLA

ESCENARIO E (VIAL) COMPARADO CON U (S/CONT. EN ACAJUTLA)

	2000-2004	2005-2029
BENEFICIOS ECONOMICOS AÑO FINAL	57	49
COSTOS ECONOMICOS DE INVERSION	138	
COSTOS ECONOMICOS PREINVERSION	17	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE LOS BENEFICIOS	19.29%	0.16%
AÑOS DE CONSTRUCCION	1	
PERIODO DE EVALUACION	31	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	270
VP(BENEFICIOS)	398
VPN	128
TIR	22.02%

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - ACAJUTLA
ESCENARIO E (VIAL) COMPARADO CON U (S/CONT. EN ACAJUTLA)
Proporción de los contenedores adicionales atendidos por el muelle "D" x beneficios de atender contenedores en Acajutla
Se supone que la Terminal de Contenedores en Cutuco sea establecida.

EVE-TCAC.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	700	550
COSTOS DE MANTENIMIENTO	0	0
COSTOS ESTIMADOS PREINVERSION	70	68
BENEFICIOS EN CTS. OPERACION - 2005	74	48
BENEFICIOS EN AHORRO EN PUERTO	12	8
BENEFICIOS TOTALES	85	56

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - ACAJUTLA
ESCENARIO E (VIAL) COMPARADO CON U (S/CONT. EN ACAJUTLA)

	2005-2015	2015-2035
BENEFICIOS ECONOMICOS ULTIMO AÑO	290	769
COSTOS ECONOMICOS DE INVERSION	550	
COSTOS ECONOMICOS PREINVERSION	68	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	17.92%	5.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	1,087
VP(BENEFICIOS)	1,821
VPN	733
TIR	18.81%

E

PROYECTO: TERMINAL DE CEREALES - ACAJUTLA
CALCULO DEL ESPECIALISTA

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	132	104
COSTOS DE MANTENIMIENTO - 2010	3	2
COSTOS ESTIMADOS PREINVERSION	13	13
BENEFICIOS EN CTS. OPERACION - 2010	0	0
BENEFICIOS EN AHORRO EN PUERTO	13	8
BENEFICIOS TOTALES	13	8

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - ACAJUTLA
CALCULO DEL ESPECIALISTA

BENEFICIOS ECONOMICOS TOTALES	22
COSTOS ECONOMICOS DE INVERSION	104
COSTOS ECONOMICOS PREINVERSION	13
TASA DE DESCUENTO	12.00%
TASA DE CRECIMIENTO DE BENEFICIOS	3.37%
AÑOS DE CONSTRUCCION	2
PERIODO DE EVALUACION	32
AÑOS DE BENEFICIOS DEL PROYECTO	30
VIDA UTIL DEL PROYECTO	30

VP (COSTOS)	139
VP(BENEFICIOS)	98
VPN	(42)
TIR	10.82%

PROYECTO: REHABILITACION MUELLE CUTUCO
ESCENARIO E COMPARADO ESCENARIO J SIN MUELLE

EVE-JCUT.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	44	34
COSTOS DE MANTENIMIENTO	4.58	3.67
COSTOS ESTIMADOS PREINVERSION	4.38	4.26
BENEFICIOS EN CTS. OPERACION - 2000	14	9
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	14	9

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: REHABILITACION MUELLE CUTUCO
ESCENARIO E COMPARADO ESCENARIO J SIN MUELLE

BENEFICIOS ECONOMICOS ULTIMO AÑO	46
COSTOS ECONOMICOS DE INVERSION	34
COSTOS ECONOMICOS PREINVERSION	4
TASA DE DESCUENTO	12.00%
TASA DE CRECIMIENTO DE LOS BENEFICIOS	5.59%
AÑOS DE CONSTRUCCION	1
PERICDO DE EVALUACION	31
AÑOS DE BENEFICIOS DEL PROYECTO	30
VIDA UTIL DEL PROYECTO	20

VP (COSTOS)	111
VP(BENEFICIOS)	132
VPN	21
TIR	16 85%

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - CUTUCO
ESCENARIO H (C/TERM. CUTUCO) COMPARADO CON C (INTERMODAL)
Sin limite de capacidad para contenedores en Acajutla

EVC-TCU2.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	438	345
COSTOS DE MANTENIMIENTO - 2010	12	10
COSTOS ESTIMADOS PREINVERSION	44	43
BENEFICIOS EN CTS. OPERACION - 2010	46	30
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	46	30

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - CUTUCO
ESCENARIO H (C/TERM. CUTUCO) COMPARADO CON C (INTERMODAL)

BENEFICIOS ECONOMICOS TOTALES	512	
COSTOS ECONOMICOS DE INVERSION	345	
COSTOS ESTIMADOS PREINVERSION	43	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	20.06%	8.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	593
VP(BENEFICIOS)	227
VPN	(366)
TIR	7.62%

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - CUTUCO
ESCENARIO H (C/TERM. CUTUCO) COMPARADO CON E (VIAL)
Sin limite de capacidad para contenedores en Acajutla

EVE-TCU2.WK4

TABLA DE INDICADORES DEL PROYECTO O PROGRAMA (EN MILLONES DE COLONES DE 1994)

RUBRO	PRECIOS MERCADO	PRECIOS ECONOMICOS
COSTOS ESTIMADOS INVERSION	438	345
COSTOS DE MANTENIMIENTO - 2010	12	10
COSTOS ESTIMADOS PREINVERSION	44	43
BENEFICIOS EN CTS. OPERACION - 2010	15	10
BENEFICIOS EN AHORRO EN PUERTO	0	0
BENEFICIOS TOTALES	15	10

MODELO DE INDICADORES DE EVALUACION ECONOMICA

PROYECTO: TERMINAL ESPECIALIZADA DE CONTENEDORES - CUTUCO
ESCENARIO H (C/TERM. CUTUCO) COMPARADO CON E (VIAL)

BENEFICIOS ECONOMICOS TOTALES	128	
COSTOS ECONOMICOS DE INVERSION	345	
COSTOS ESTIMADOS PREINVERSION	43	
TASA DE DESCUENTO	12.00%	
TASA DE CRECIMIENTO DE BENEFICIOS	13.71%	8.00%
AÑOS DE CONSTRUCCION	3	
PERIODO DE EVALUACION	33	
AÑOS DE BENEFICIOS DEL PROYECTO	30	
VIDA UTIL DEL PROYECTO	30	

VP (COSTOS)	593
VP(BENEFICIOS)	108
VPN	(485)
TIR	2.79%

ANNEX 10.2.3

ADDITIONAL SENSIVITY ANALYSIS OF RAIL REHABILITATION

Se ha hecho análisis adicionales de sensibilidad sobre la factibilidad de rehabilitacion del ferrocarril en cuanto al impacto financiero de variaciones en los pronósticos de tráfico y los beneficios económicos en ahorros de mantenimiento vial y de divisas por disminución en el costo total de operación de camiones. Para estos análisis, se ha escogido el Escenario 3C (Distritos 3 y 2 via Santa Ana).

En síntesis, no habría importante variación en los resultados financieros. En cuanto al análisis económico, en total serían cerca de 7.4 millones de colones adicionales de beneficios, lo que no es suficiente para cambiar significativamente los indicadores de factibilidad.

1. ANÁLISIS FINANCIERA

1.1 Variación en el Volumen de Tráfico

En el Cuadro 1 se presenta una pequeña reduccion en el resultado operacional de la suma de los impactos de un incremento de 100% sobre el tráfico del Distrito 3, de la carga importada, y una reducción de 40% del tráfico de puzolana de Ciudad Arce a Metapán, al mantener la participación parcial del camion en este transporte.

2. ANÁLISIS ECONÓMICA

2.1 Ahorros de Mantenimiento Vial

En el Anexo 3.12.1 del capítulo 3 (Cuadro A.3.12.25) se ha calculado el costo de mantenimiento periódico por camion C3S2. El costo de mantenimiento rutinario no varia con el tráfico. El costo anual promedio en el período 1995-2014 es de 3,184 colones; el percurso anual es de 21,000 km; y se supone un peso promedio cargado de 15t. Por tanto, el costo adicional de mantenimiento vial de un camión por km y la distancia promedio del percurso del tráfico férreo son:

Costo de mantenimiento/t-km =	0.0101 Colones
Distancia promedio de percurso del tráfico férreo =	117 km

De implementarse el escenario 3C, los beneficios a lograr serían aproximadamente de 1.4 millones de colones en el año 2015. Por otro lado, si se opta por el escenario 5 (cierre) se ahorrarían cerca de 18 millones apenas con el costo de mantenimiento del ferrocarril,.como se muestra en el Cuadro 2.

En cuanto al costeo del mantenimiento, el análisis de cargos a los usuarios viales indica que el usuario vial actualmente paga por medio de varios cargos los gastos del sector. En 1992, se observa en los Cuadros 3.3.6 y 3.3.7 ingresos fiscales por concepto de transporte vial de 356 millones de colones y gastos viales de 375 millones. Los cargos

pagados por los transportistas hacen parte de sus costos que normalmente cobran a sus clientes. La sola diferencia es que el propietario del automóvil privado paga más de su parte del costo de mantenimiento vial, indirectamente subsidiando en algo el transporte por camión

2.2 Ahorros de Divisas de la Operación de Vehiculos

Actualmente, usando recursos nacionales por medio del ferrocarril vendría a traer otra ventaja cuando comparado con camiones, que usan más recursos importados, consumiendo divisas. Las divisas podrán tener un precio sombra más elevado que el capital nacional.

En los Cuadros 3 y 4 se calculan los ahorros en divisas que se puede esperar y los beneficios correspondientes. Se estima que la reducción en las necesidades de divisas llegue a casi 60 millones de colones en el 2015. Suponiendo que el precio sombra de la divisa sea 10% más que el precio sombra del capital nacional, los beneficios económicos serían de cerca de 6 millones de colones en el 2015.

FACTIBILIDAD ECONOMICA Y FINANCIEIRA DE LA REHABILITACION DEL FERROCARRIL
ANALISIS ADICIONALES DE SENSIBILIDAD - ESCENARIO 3C (Distritos 3 y 2 via Santa Ana)

Cuadro 1

Análisis Financiera - Vanación en el Volumen de Tráfico

Tráfico	Variación	Ingreso/t	2000	2005	2010	2015
Puzolana (Ciudad Arce - Metapán)						
	miles de toneladas		(54)	(69)	(89)	(114)
	ingreso en miles	42.5	(2,295)	(2,941)	(3,774)	(4,828)
	costos en miles		(1,078)	(1,195)	(1,297)	(1,326)
	resultado operacional		(1,217)	(1,746)	(2,477)	(3,502)
Diversos (Acajutla-San Salvador)						
	tráfico en toneladas		45	57	73	107
	ingreso en miles	41.44	1,865	2,362	3,025	4,434
	costos en miles		876	960	1040	1,218
	resultado operacional		989	1,402	1,985	3,216
Total						
	tráfico en toneladas		(9)	(12)	(16)	(7)
	ingreso en miles		(430)	(579)	(749)	(394)
	costos en miles		(202)	(235)	(257)	(108)
Total	Variación total ingreso		(228)	(344)	(491)	(286)

Cuadro 2

Análisis Económica - Ahorros de Mantenimiento Vial

(Costo de mantenimiento/t-km = 0.010108 Colones)
(Distancia promedio de percurso tráfico férreo: 117 km)

Año	2000	2005	2010	2015
Tráfico (en miles de t)	631	785	957	1,166
Costo mant. vial	746,239	928,363	1,131,776	1,378,945
Costo mant. FFCC	17,910,000	17,910,000	17,910,000	17,910,000

Cuadro 3

Análsis Económica - Ahorros de Divisas en la Operación de Vehículos

(Costo operación camión pesado, via primaria ondulada buena, 50 km/h: 9.50 ¢/veh-km
Proporción del costo en divisas (total - mano de obra de oper. y mant.): 75%
Costo en divisas por vehículo-km: 7.13)

Item	Año	2000	2005	2010	2015
3.1 Transporte Vial					
Tráfico (en miles de t)		631	785	957	1,166
Camión-km		4,921,800	6,123,000	7,464,600	9,094,800
Costo en divisas		35,067,825	43,626,375	53,185,275	64,800,450
3.2 Transporte Férreo					
Proporción del costo de operación en divisas:			20.1%		
Costo operación ferrea		34,570,000	35,180,000	35,990,000	36,990,000
Costo en divisas		6,948,570	7,071,180	7,233,990	7,434,990
3.3 Ahorro en Divisas					
Reducción de divisas		28,119,255	36,555,195	45,951,285	57,365,460
Valor relativo (10%)		2,811,926	3,655,520	4,595,129	5,736,546

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Cuadro 4
Proporción de los Costos Ferroviarios en Divisas

REHABILITACION		
Material extranjero (metálico)		80,224
Total sin imprevistos		385,772
Proporción del costo en divisas		20.8%
OPERACION - AÑO 2000		
Material extranjero		
Mantenimiento	20.8%	3,682,919
Combustibles/lubricantes		2,388,000
Herramientas		45,000
Papel y útiles		149,000
Repuestos		356,000
Equipo		6,000
Costo Total Material Extranjero		6,626,919
Costo Total de Operación		32,825,000
Proporción Divisas		20.2%