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COMITE PERMANENT INTERETATS DE LUTTE CONTRE LA SECHERESSE DANS LE SAHEL

COMMISSION DES COMMUNAUTES EUROPEENNES

REGIONAL LPG PROGRAM

REGIONAL STUDY ON LPG PRICES AND SUPPLY

Part II : TRANSPORT

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Seed

Stratégie Energie Environnement Développement
11 bd Brune, 75014 PARIS, France. Tél 33.1.45.45.90.32 - Fax 33.1.45.45.31.08

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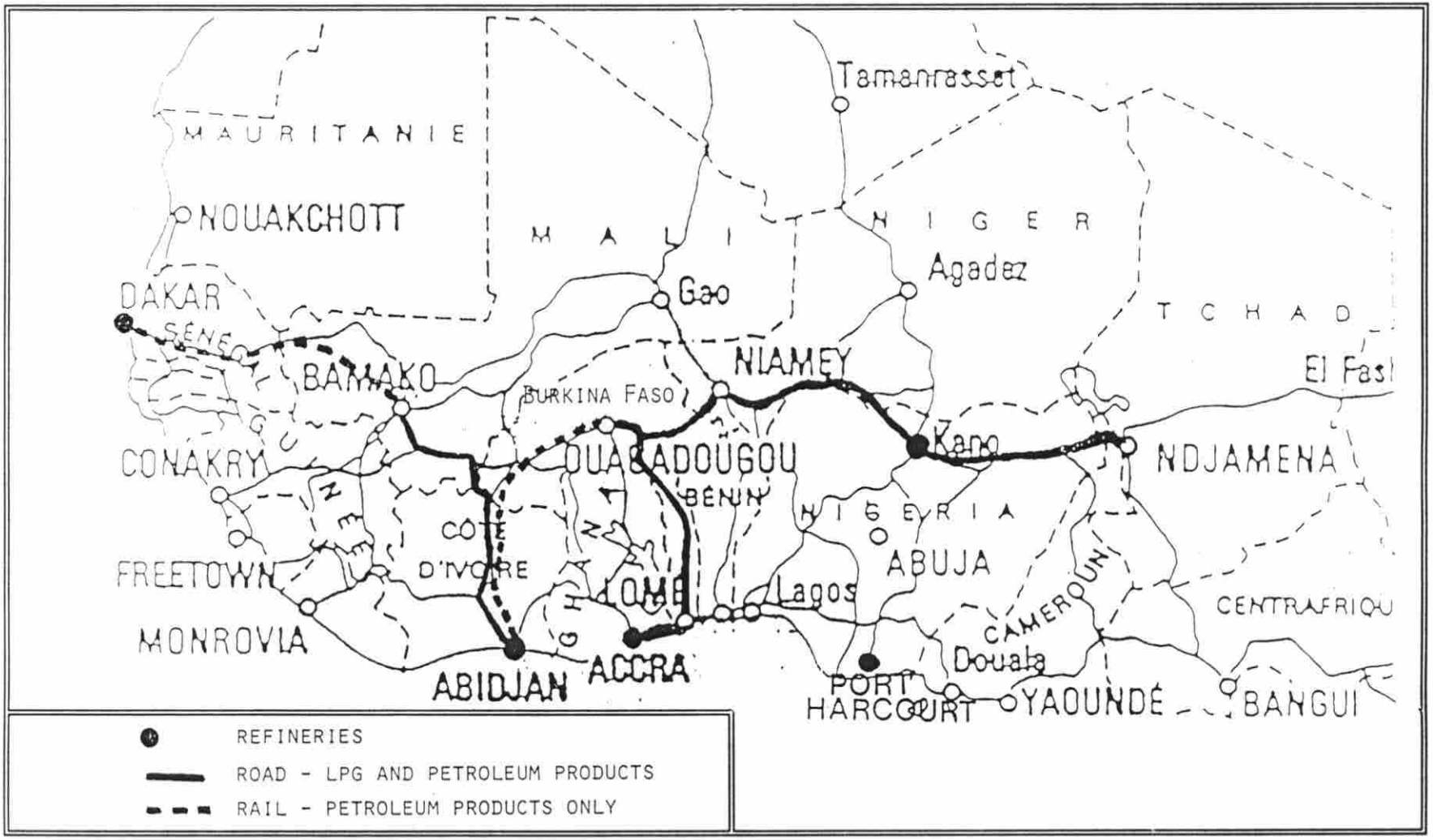
WEST AFRICA LPG SUPPLY SOURCES AND ROUTES



1. ORGANIZATION OF PROCUREMENT AND SUPPLY

1.1 COUNTRIES WITH REQUESTS FOR BIDS

Four of the CILSS countries procure their LPG supplies in the international market through an international tendering process; these are:

- Cape Verde
- Guinea-Bissau
- Mauritania
- Senegal

It is significant to note that these countries are all coastal with direct access, through marine terminals on their own territory, to the international tanker-supplied market. All the remaining countries except Gambia are landlocked and depend on the coastal transit countries to obtain their supplies.

1.11 Cape Verde

The two marketing companies ENACOL and SHELL jointly manage the tendering and procurement exercise. One small tanker cargo of approximately 1,200 tons is purchased every 2 to 3 months. Thus the marketing companies set out several tenders each year, for one or two cargos.

1.12 Guinea-Bissau

The state company, DICOL, manages the tendering and procurement process. One parcel of about 600 tons is acquired every 12 months; because of the extremely high inventory financing charges, and high depot capital and operating cost versus a somewhat lower freight it is questionable whether this parcel size and frequency is optimum. Most of the depot cost is capital and could not be reduced through more frequent deliveries, but it is noted that they have increased their allowable depot loss figure to 4% from 1% in the price structure. This probably reflects high actual observed losses on product sitting in storage an average of 10 months or so. The inventory financing cost for carrying an average inventory of about 400 to 500 tons in relation to a market of 600 tons per year, is enormous.

1.13 Mauritania

The company SOMAGAZ manages the tendering and procurement process. One year's supply is tendered for annually based on a 700 to 800 ton parcel delivered every month. It appears that this parcel size and frequency of delivery is below the optimum for an annual market of some 9,000 tons and SOMAGAZ is undertaking capital expenditures to expand the capacity of the main receiving depot as well as studying the feasibility of upgrading port facilities to be able to accommodate larger tankers.

1.14 Senegal

The 2/3 of LPG supply that is deficit to the SAR refinery production is procured by SAR based on twice-yearly tenders for 6 months supply in multi-cargo deliveries at international SPOT market rates FOB plus small tanker freight. The frequency of delivery is generally 2 to 3 weeks with parcel sizes of 1,500 to 2,000 tons. Occasionally it is found to be more economic to specify a larger parcel size, about 3,000 tons, than can be accommodated by the capacity of the receiving depot. The 3,000 ton tanker unloads a part cargo, say 2,000 tons, and then waits outside port for about a week for ullage in the depot sufficient to discharge the remaining 1,000 tons. Additional storage in the system (SENGAZ near the refinery as well as SHELL, totalling some 3,400 tons incremental) should allow the main receiving terminal to be freed up allowing enough ullage after minimum security stocks, to discharge 3,000 ton tankers on a regular basis without the extra demurrage/waiting charge being incurred.

1.2 COUNTRIES WITH OTHER, LESS STRUCTURED SUPPLY ARRANGEMENTS

1.21 Gambia

The four private LPG importers/distributors in Gambia each have their own supply arrangements. There is no formal, centralized tendering process or established, transparent posting from a major supply point such as Senegal. In principle they can obtain supplies by bulk truck from SENGAZ or SHELL depots in neighboring Senegal at less than US$ 300 per ton at load point; since the nearest depot and bottle-filling centre, Kaolack, is quite close they can also import in bottles at quite economic prices delivered to Banjul. In practice, the political situation appears to restrict this most economic supply most of the time. Instead, two of the four are importing in containers from European sources at delivered prices that are in excess of US$ 1,000 per ton, before bottling and final distribution costs are added on. It is difficult to see how they could compete with any significant bulk or bottled volumes from Senegal, but reliability may be the key. The Senegal supplies may be subject to cut-offs due to the political situation.

The remaining four CILSS countries, Mali, Burkina Faso, Niger and Chad are landlocked and obtain their supplies by bulk road tanker from neighboring countries. The arrangements are similar to that of a posted ex-depot or ex-refinery rack price where truckload quantities are generally available at short notice. The rack price may in some cases be specific to the particular purchaser in other cases the posting is common to all purchasers who show up with a truck for loading. Even in the case where the country may have a specific agreement from a neighboring supplier, the price and payment terms are generally similar for all similar purchasers.

1.22 Mali

The two LPG marketers in Mali, SHELL and TOTAL import their supplies from the SIR refinery Abidjan at the negotiated posting ex-refinery established for Mali of CFAF 110,000/ton. Supplies are normally available at all times for loading at short notice, payable in CFAF with normal commercial credit facilities. The loading rack is actually at the

satellite depot of GESTOCI (CI state-owned petroleum storage company), located near the SIR refinery, and the extra depot throughput cost and other small charges puts the rack price loaded into trucks at CFAF 122,000/ton.

1.23 Burkina Faso

The sole importer, state-owned SONABHY, import most of their requirements from SIR/GESTOCI, Abidjan at the negotiated price established for Burkina Faso of CFAF 100,000/ton ex-refinery or CFAF 110,000/ton loaded into trucks at the GESTOCI rack. Supplies are normally available at all times for loading at short notice, payable in CFAF with normal commercial credit facilities. Another supply option that has been used sporadically by SONABHY is the Tema refinery in Ghana. It represented 11% of supply in 1990, 89% from SIR Abidjan. The Ghana National Petroleum Corporation (GNPC) has established an export price for all truck loadings at the refinery rack of US$ 200/ton. Although in principle the supply from here is more economic than from SIR Abidjan there are constraints which prevent Tema from being the major source:

- Supply is unreliable, there is not surplus for export at all times.
- Payment terms are more onerous; full payment in US$ for each truckload must be deposited in a bank acceptable to GNPC, in advance of loading.
- Road conditions on the shortest route through Ghana are generally poor and completely untenable during the rainy season; the alternate route through Lomé, north through Togo is very costly in official and "unoffical" road transit/toll charges.

1.24 Niger

The two importers in Niger are authorized to procure their supplies from Nigeria. There is no pre-agreed supply contract, but Nigeria fixes a quarterly price ex-refinery; it is currently US$ 250/ton. The NNPC official export price policy for the neighboring West African countries, is CIF NWE per Platts LPGaswire less US$ 30/ton. The most economic source is the Kaduna refinery but supply constraints there have forced them to load at times in the Port Harcourt refinery, 1,000 km further south. Exports from Nigeria were suspended altogether since August 1991 and supplies have been obtained from Tema, Ghana at the established export price of US$ 200/ton loaded there. With the startup of a new LPG recovery unit in November, the Kaduna supply situation should be resolved and supply should be readily available. There are frequent political problems in the North of Nigeria, however, which cause the border to be closed and supplies to be disrupted.

1.25 Chad

The two importers in Chad, TOTAL and SHELL, import by truck from Nigeria at the posted price indicated above. TOTAL appears to have a better arrangement with its supplier through its sister company TOTAL Nigeria, than is the case with SHELL. TOTAL has consistently obtained supplies from Kaduna, while SHELL, unsupported by a fully-owned affiliate there, has had to source from Port Harcourt at times at great extra cost.

2. INFRASTRUCTURE

2.1 MARINE TERMINALS

There are marine terminals for receiving LPG tankers, located in the coastal CILSS countries: Mauritania, Senegal, Guinea-Bissau and Cape Verde, primarily to serve their own national markets, as well as in non-CILSS coastal countries: Ghana, Cote d'Ivoire and Nigeria which may serve as sources for the CILSS landlocked countries Mali, Burkina Faso, Niger and Chad. These three non-CILSS supply sources, in addition to having the capability of receiving LPG by tanker from international markets are also significant producers of LPG from refineries located on the coast at the same terminal locations. Nigeria has a major inland refinery at Kaduna which serves as prime supply point for Niger and Chad. (see price document). The storage capacity of CILSS and non-CILSS marine terminals as well as at major inland depots is discussed and summarized below.

2.2 STORAGE CAPACITY

2.21 Capacity Outside CILSS

2.211 Cote d'Ivoire/Abidjan

Refinery LPG Storage

SIR has only some 2,500 tons of total LPG storage; this is about two weeks production (little more than minimum working requirements). This severely limits the refinery's ability to build up decent cargo sizes for exportation of surplus. As part of the refinery modifications to be in place by 1994, resulting in more LPG produced for sale, more LPG storage is proposed.

GESTOCI

The GESTOCI depot in Abidjan/Vridi is connected by pipeline for all products, including LPG, to the nearby SIR refinery. It also has the capability of receiving supplies from the international market by tanker, up to 30,000 DWT, including LPG. Total LPG storage is 2,000 tons but maximum ullage is only 400 tons, since 1600 tons of security stocks must be maintained for Cote d'Ivoire at all times. This effectively limits the maximum cargo receiving size to 400 tons, at best.

The Vridi depot has a rail siding with product loading facilities. There is one loading arm for LPG which can serve both trucks and rail wagons, the latter have never been served, although facilities are new.

The landlocked countries all have the right to use GESTOCI for receiving and storing products from international markets.

Marketing Companies

The four private Ivorian LPG marketing companies, SHELL, MOBIL, AGIP and TOTAL/TEXACO each have a depot in Vridi near SIR and GESTOCI. These depots are connected by pipeline to SIR which is their principal supply source; they have the capability of receiving LPG by tanker but this would primarily be in emergency situations since small storage size severely limits the size of receiving parcels.

A summary of all storage in Cote d'Ivoire is provided below; as indicated this is all in Abidjan/Vridi (there are no up-country depots).

TOTAL LPG STORAGE IN COTE D'IVOIRE (Abidjan/Vridi)
(tons)

SIR	2,500
SHELL	550
MOBIL	150
AGIP	120
TOTAL/TEXACO (SIEPP)	185
GESTOCI	2,000
TOTAL COTE D'IVOIRE	5,505

2.212 Ghana

Tema Refinery

The total storage capacity in the refinery is 1,200 tons. A minimum security stock of 700 tons is maintained for the country at all times, leaving a maximum ullage of 500 tons. This ullage is equivalent to only about 10 days production at the enhanced production rate indicated for the near future. The short-term imbalance between production and offtake has frequently resulted in the flaring of LPG due to limited storage capacity. The refinery is considering the installation of a 1,200 ton-capacity sphere for additional storage. It is intended not only as additional working storage to balance production with offtake for the domestic market, but also to build decent-sized cargoes (e.g. 1,000 tons) for the export of any surplus. As part of a recent World Bank-financed rehabilitation project the refinery has installed a LPG line to the dock for cargo exports. This facility could be easily adapted as a receiving line for cargo imports.

There is no other LPG storage capacity in Ghana - either in the Tema/Accra area or up-country. There is a Korean project currently underway for the construction of storage depots for conventional petroleum products in three locations: Sekondi-Takoradi, Kumasi and Tamale. LPG storage will be considered at these locations in a future phase.

2.213 Nigeria

Refinery LPG Storage

The four refineries have a total of some 25,000 tons of LPG storage. Although the three coastal refineries would have a capability of receiving LPG tanker supplies into their tanks, this is not normally a practice nor would use of this storage for importation be available to third parties. The capacity is broken down as follows:

	TONS
Port Harcourt (I & II)	9,000
Kaduna	9,000
Warri	7,000
TOTAL AT REFINERIES	**25,000**

Marketing Companies

There are some ten companies marketing LPG in Nigeria. In addition to large depots in Lagos, there are about 70 small, up-country filling plants owned by the distributing companies with storage ranging from 5 tons to 100 tons at each. The three largest Lagos depots are TOTAL (1,100 tons), African Petroleum (800 tons), and NIDOGAS (550 tons).

Regional, Up-Country

Nigeria, through NNPC, is presently engaged in a LPG program which has much the same objectives as the programs elsewhere in the region. The main capital project element in this program is the construction of nine bulk storage depots throughout the country. There are also elements of publicity, education of the public, bottle subsidies etc. which are not as well developed yet as the regional depot project. The project entails the installation of a total of 12,000 tons of storage in 9 depot locations: one of 4,000 tons in Lagos and 8 of 1,000 tons each in Ibadan, Ilorin, Kano, Gusau, Gombe, Makurdi, Enugu, Calabar.

The depots will be replenished by truck at the beginning but eventually they hope to install pipeline connections as with the white product depots at present. The depots will be strictly for bulk supply to the distributing companies who already have their own networks of small depots and filling facilities throughout the country (predominantly in the south).

2.22 CILSS Capacity

Annex provides details of the depot storage infrastructure in each country. The following table summarizes this data for the entire country group. As indicated total storage, predominantly in marine terminals, is 11,276 tons, representing 80 days of consumption for CILSS as a whole.

LPG STORAGE CAPACITY - CILSS
(tons)

COUNTRY	Marine depot capacity	Truck-supplied capacity	TOTAL capacity	Days consump
Burkina Faso	-	200	200	39
Cape Verde	1,662	-	1,662	110
Chad	-	50	50	128
Gambia	-	51	51	23
Guinea Bissau	800	-	800	487
Mali	-	148	148	52
Mauritania	5,000	150	5,150	208
Niger	-	95	95	62
Senegal	3,120	not avail.	3,120	35
TOTAL CILSS	**10,582**	**694**	**11,276**	**80**

2.3 TRANSPORT CAPACITY

2.31 Highways

The length and condition of highway routes from coastal supply points and extent of official and unofficial tolling and transit charges by the transit countries bear critically on the LPG supply cost and supply reliability to the landlocked countries of Mali, Burkina Faso, Niger and Chad. The following are the main routes for truck replenishment of LPG depots in these countries:

2.311 Abidjan - Bamako

The sole route for LPG supply to the SHELL and TOTAL depots in Bamako and the SHELL Mopti depot is from the GESTOCI depot in Abidjan/Vridi, traversing Cote d'Ivoire north to the border with Mali at Zegoua and then to Bamako, either via Segou or via Bougouni. The Bougouni route is shorter, a total of 1,227 km compared with 1,379 km for the Segou route, but was out-of-service until recently due to bad condition. The total Vridi-Mopti distance is 1,318 km. The route is fully asphalted and considered "A" class the full distance. Besides the major border crossing delay for customs documentation and payments there are a number of checkpoints along the route where both official and "unofficial" payments are made. They have been achieving only two rotations per month on the route but could readily achieve three. The incentive to do so has not been great because of spare trucking capacity.

2.312 Abidjan - Bingo (near Ouagadougou) and Bobo-Dioulasso

One of the two supply routes for replenishment of the SONABHY depots in Burkina Faso is from Abidjan/Vridi to Bobo-Dioulasso a distance of 820 km. or to the Bingo depot near Ouagadougou, a distance of 1,150 km. The road is asphalted "A" class the full distance. They could achieve 4 rotations per month but their present trucking capacity only requires an average of two rotations.

2.313 Tema, Ghana - Bingo/Bobo

SONABHY also sources sporadically from the Tema refinery in Ghana. It generally transports this north through Togo via Lomé, a distance of 1,150 km to the Bingo depot. The road is asphalted "A" class but the official and unofficial checkpoint stops are costly in direct payments (200 to 300 thousand CFAF per truck) and in the indirect cost of delay time. Another possible route for the future is north through Ghana via Kumasi and Tamale, a distance of 1,030 km to Bingo. This is not feasible vs. the Lomé route at present since the section north of Tamale to the Burkina Faso border is in bad condition. Based on road projects that have been defined and will be financed through development aid, the highway route to Burkina Faso through Kumasi and Tamale to Navrongo at the border should be first-class paved road in its entirety by 1996. There are no highway transit charges payable by the land-locked country trucks passing through Ghana.

2.314 Kaduna - Niamey

The preferred supply point for Niger Gaz is the Kaduna refinery of NNPC in northern Nigeria, 1,000 km from Niamey. The road is paved "A" class and the truckers can achieve 3 to 4 rotations per month.

2.315 Port Harcourt - Niamey

At times there are problems with supply from Kaduna and trucks must divert to another NNPC refinery in Port Harcourt 1,000 km further south on the coast, a total distance of 2,000 km to Niamey.

2.316 Tema - Niamey

At times the Nigerian supply is completely cut off due to border closings or political activity or unrest in Nigeria. In this case the Niger importers have been lifting from Tema, a distance of 1,500 km from Niamey. Even though this distance is shorter than Port Harcourt, the latter is the preferred supply point if Kaduna is not available and the Nigerian border is open.

2.317 Kaduna - N'Djamena

The preferred supply point for SHELL and TOTAL in Chad is the Kaduna refinery, some 1,090 km from N'Djamena. The road is class "A" paved in Nigeria, but includes about 100 km of bad road traversing northern Cameroon. The Cameroon portion is also the most difficult section for delays and transit charges. The trucks are regularly held up for three days in this portion and have been known to wait for as much as three weeks. The trucker for TOTAL Chad averages about three weeks per rotation but there is plenty of spare capacity and TOTAL indicates that they could push harder, using their Nigerian and Cameroon affiliates as expediters as the supply/demand volume increases. Both suppliers have faced run-outs because of the closing of the Nigerian border for as much as a month at a time. TOTAL has had more success than SHELL at sourcing from Kaduna all the time. SHELL has been forced to lift from Port Harcourt at times, 1,000 km to the south.

2.32 Truck Fleets, Capacity

Annex provides details of number and capacity of trucks (primarily in the four Sahel countries). The total trucking capacity is summarized below. As indicated there are a total of 20 trucks in the entire Sahel with a total carrying capacity of 388 tons. This represents 39 days consumption, compared with average rotations on their supply routes of about 10 days. Capacity is at least four times requirements at present supply volumes/consumption since the trucks are not being pushed or expedited to perform better; rotation time could be reduced below these inefficient levels.

LPG TRUCK FLEET - SAHEL COUNTRIES

Country	Number	Fleet capacity (tons)	Days consumption
Mali	5	110	38
Burkina Faso	10	200	39
Niger	3	48	31
Chad	2	30	77
TOTAL Sahel	20	388	39

2.33 Railways

There are two railway systems in the CILSS countries:

2.331 Dakar - Bamako (RCFS/RCFM)

The railway runs from Dakar east to the Mali border and on to Bamako terminating in Koulikoro (just beyond Bamako on the Niger river). The major destination in Mali is Bamako, but there are several sidings for offloading between the border and Bamako in Kayes, Diamou, Mahina, Toukoto and Kita. The rail distance from Dakar to the Mali border is 643 km, Dakar-Kayes 748 km and Dakar-Bamako 1,231 km. The railway carries a major portion of Mali's supplies from the major port of Dakar; it carries passengers as well as freight.

One of the more important cargoes carried is liquid petroleum products from the SAR refinery in Dakar for offloading in Mali -primarily in Bamako at the MOBIL depot but also at small depots in Kayes and the other offloading points between Kayes and Bamako. LPG has never been carried on this system; there is no experience with the size and configuration of specialized tankwagon that might be hauled or what equipment and handling limitations there might be.

Based on the current rail tariff and SAR posted prices, the SAR refinery/railway/MOBIL depot/local truck supply system is the most economic supply mode for 90% of Mali's total petroleum product requirements. In spite of having more than sufficient tankwagons to meet this volume of haulage the railway has never managed to haul more than about 80,000 tons in a year, which is about 45% of Mali's total requirements of 180,000 ton/yr. It has averaged about 60,000 ton/yr in recent years.

There is a management deficiency which can be illustrated by the total tankwagon fleet available on the system: 140 wagons with a total capacity of 5,280 tons. The average yearly volume carried represents a fleet rotation of slightly less than once per month, and at the maximum ever achieved they had a rotation of 1.3 per month. In order to achieve the economic optimum for Mali and save the country millions of dollar per year vs. the more expensive Abidjan supply axis, they would have to have an average fleet rotation of just 2.6 per month, i.e. one wagon every 12 days. This should be easily achievable on even a moderately well-managed system.

In this management context it is not advisable to propose the carriage in pressurized wagons of an additional new, pressurized, hazardous product in a system that is performing at less than 40% of capacity to the financial/economic detriment of Mali. If LPG were carried and managed properly and with safety (fire hazards etc.), it would undoubtedly reduce the amount of conventional products carried and at best Mali would make no net economic gain. At worst, these very expensive, new, specialized wagons would receive the same poor turnaround treatment as the existing wagons, meaning a fleet requirement and capital investment for a given volume carried 2.5 to 3 times the optimum. Under this scenario the existing truck replenishment of LPG from Abidjan would be more cost-efficient.

2.332 Abidjan - Ouagadougou (SICF)

The Société Ivoirienne de Chemin de Fer system runs north from Abidjan to the Burkina Faso border and on through Bobo-Dioulasso, terminating in Ouagadougou. The track is narrow gauge, 1 metre and the weight limit for wagons is 17 tons per axle for a total of 68 tons for a 4 axle wagon. Petroleum products are loaded into rail wagons in the GESTOCI depot, Vridi and shipped to the SONABHY depots at Bobo and Bingo. Vridi -Bobo is 817 km and Vridi-Bingo 1,151 km. The system does not haul LPG wagons and the officials of SICF had no experience with this specialized haulage. Discussions with TOTAL Abidjan resulted in the comment that the special dimensioning and different center-of-gravity of these wagons might not be a compatible with the narrow gauge and other characteristics of this railroad. The tariff on regular products to Bobo/Bingo works out to be about US$ 0.11 to US$ 0.12 per ton-km, depending on the product. This compares with US$ 0.13 per ton-km by road. It appears that this railway also suffers from management problems and/or capacity constraints because a significant amount of product moves by road. Many shippers would prefer the flexibility and relative independence of road haulage if the differential between rail and road tariff is only about 10%. This order of differential would certainly not be enough to justify major investment in expensive, specialized LPG rail wagons.

3. SUPPLY OPTIONS FOR EACH COUNTRY

3.1 LANDLOCKED COUNTRIES

The countries which require the most support for LPG market development among the CILSS group are the four Sahel countries, Mali, Burkina Faso, Niger and Chad. Although the private sector is making progress with the market, encouraged by the CILSS subsidies at the consumer level, it is important that positive reinforcement be provided from the supply side and that any negative impediments to market growth be removed from this segment of the supply/distribution chain. The single most important factor in market growth is the end-price to the consumer. The full-cycle cost of fuel, bottle and cooking equipment must be attractive and affordable compared with other fuels. To this end, direct consumer subsidies are encouraged and recommended to be enhanced if possible; given demand pull from the consumer the private sector will generally respond by building the appropriate infrastructure without the need for significant subsidies to this segment of the business. There are, however, aspects to the Sahelian supply structure which can be responsive to some limited investment support. Financial support to the operators in advancing the installation of incremental or new depot storage can have two effects:

- The positive effect of a reduced total supply cost and reduced price to consumers can be effected through the ability to maximize the supply from sources that are traditionally very cheap, but sporadic and undependable; examples of such sources are Tema refinery for SONABHY, Burkina Faso, and Kaduna in Nigeria for the Niger and Chad operators. When supplies from these sources are readily available inventories can be built to higher levels to bridge the period when they are not available.

- The elimination of the negative effect on markets and market growth of "run-outs". It is especially important with a product like LPG that the customer can count on complete reliability of supply. Sporadic supply due to run-outs will severely dampen market growth and penetration. An example is the run-outs experienced in Niger and Chad due to Nigerian border closings; extra storage capacity will allow for extra stocks to be carried to bridge such a contingency.

The reason for support to the operator in advancing such storage installation, when it is recognized that he will generally respond to market signals by building the appropriate infrastructure, is due to his risk-reduction behaviour. In order to reduce risk in an uncertain world the operator will always tend to lag a bit behind market growth in construction of expensive fixed installations like depot storage, for fear of overbuilding. The present storage in these countries may be about right from a cautious private operator's perspective but is not necessarily the optimum to encourage market growth at a level that would eliminate most suppressed demand.

As well as supporting the addition to centralized storage and bottling in the main centres a positive impetus to price reduction and supply reliability would be to provide support to the installation of decentralized storage outside the main centres for targetting up-country urban markets. This is also a situation where the private sector will eventually

respond through a low-risk cautious approach but there is a case here also for advancing or pre-building storage and bottling up-country.

In this respect, it is worth recalling that consumptions/throughputs of at least 100 tons per year would be necessary in such local markets to justify bulk truck movements into a small plant. Few such decentralized markets would emerge in landlocked countries in the next years.

One option, consisting of intermediate storage capacities between costal refineries/depot and inland depots, for dispatching the flows, has been sometimes suggested. However, because of small market size, this option is not viable: the addition of new depot throughput costs would yield a higher total cost compared to the present road transport cost between the coast and inland depots.

3.11 Specific Options

3.111 Mali

In terms of present, workable supply systems Mali is technically limited to road tanker supply from Abidjan/SIR/GESTOCI, Tema, Ghana and Kaduna or Port Harcourt, Nigeria. In spite of a lower posted price at the Tema and Kaduna supply points the latter two systems are not economically viable vs. Abidjan because of road distance, transit charges and attendant trucking cost differential. The distance differential is some 900 km in the case of Tema and the Togo and Burkina transit charges up to CFAF 300,000 per truckload, must be added on. In the case of Kaduna the distance differential is some 1,250 km and there are the transit charges in Burkina to be added on.

LPG market potentials in small centres like Kayes or Gao will not justify a bulk supply/storage set up for several years. The next logical bulk storage/filling plant prospects would be the Mali East and Centre populations such as Mopti (SHELL is apparently struggling to justify maintaining its facility there), Ségou and Sikasso. These, along with Bamako are most efficiently supplied from Abidjan.

Supplying Bamako by rail from Dakar remains potentially an economic solution in the long term. However, the lack of loading/unloading and storage equipment and of a rail terminal is not the only obstacle for the implementation of such an option. It is rather the inability of railways to reach satisfactory rotation frequencies, as indicated in chapter 2. Nevertheless, this report provides the terms of reference for a study on rail transport of LPG, both for Mali and Burkina Faso, which is annexed in part 1.

3.112 Burkina Faso

Burkina Faso is technically limited to supplies by road from Abidjan, Tema and Kaduna or Port Harcourt, Nigeria. Sourcing from Tema results in the lowest landed cost but supplies are not reliable. Abidjan is the prime source, although Kaduna supplies should be a bit cheaper, since the distance differential is only 390 km while the posted price from Kaduna has recently been about US$ 100 per ton cheaper than Abidjan.

Supplying Bobo Dioulasso and Ouagadougou from Abidjan by railroad is a possible option in the long term, which would be analysed within the same study as the one proposed for Mali.

3.113 Niger

Niger is technically limited to supplies by road from Kaduna or Port Harcourt in Nigeria, Tema in Ghana and Abidjan. The most economic supply is Kaduna, followed by Port Harcourt, Tema and Abidjan in that order.

3.114 Chad

In addition to the prime supply point of Kaduna, Nigeria, Chad could technically source from all the truck-loading points on the highway network: Port Harcourt, Tema, Abidjan. The Tema source has a distance differential of 2,000 km. over Kaduna and Abidjan 2,300 km. Although supply could theoretically be maintained from these sources in the face of cut-offs of the prime source, the cost would be prohibitive. In the future, Chad should have the option of sourcing from its own indigenous supplies after the commissioning of the mini-refinery in 1995.

3.2 COASTAL COUNTRIES

The coastal countries with sizeable supply volume, Senegal, Mauritania and Cape Verde have the option of sourcing from international markets at a scale that reduces the unit cost of marine freight and receiving depot throughput to reasonable levels. In the case of Gambia and Guinea-Bissau the option of sourcing directly from international markets is technically open, but the small scale makes the unit freight and depot throughput cost extremely high since both these countries are connected by the road network to Dakar, Senegal the option to source from the large efficient depot there is technically open.

4. RECOMMENDATIONS

4.1 MANAGEMENT OF PROCUREMENT AND SUPPLY

4.11 Cape Verde

It appears that Cape Verde has an effective procurement of LPG from competitive international markets through a tendering process; it is not clear, however, whether this is tendered on a cargo-by-cargo basis or multi-cargo with a formula related to prevailing FOB and freight. The latter method is usually more cost-effective than tendering on individual cargos, especially with small parcels. It is recommended that this be investigated and performance be evaluated.

4.12 Chad

It is recommended that Chad should maximize its sourcing from the Kaduna refinery; this is supported by the recommended PRG support to investment in additional storage at N'Djamena.

4.13 Gambia

The Gambian operators should lift by truck exclusively from Senegal and every effort should be made to make this supply reliable. If it is a case that supplies are cut off at times from this most economic source (such as with Kaduna for Niger and Chad) for political/bureaucratic reasons, then more storage to allow for maintenance of stocks to bridge this sort of contingency would be recommended. Direct supply from international markets via containers or through a new, permanent small marine depot installation should only be considered as a last resort if supply from Senegal is out of the question; the supply cost by these modes are about three times the cost of Senegal trucked supply.

4.14 Guinea-Bissau

Even treating the costs of the marine receiving terminal as sunk investment the scale effect of freight, inventory financing charges and depot fixed costs are high. The effect of pooling with others will not be significant in reducing freight cost and could lead to countervailing inefficiencies because of the need for multi-country government collaboration and involvement in procurement. The best option may be to truck directly from Senegal. No firm information is available on the distance, condition, river crossings etc. and general feasibility of this highway route. If Senegal ex-depot supplies are available at US$ 300/ton and even if the truck freight is based on 1,000 km road trip equivalent, it should not total more than US$ 500 per ton, landed into the Bissau depot. It is recommended that the Senegal supply option be pursued.

4.15 Mali

It is recommended that the operators stick to the Abidjan/SIR posted pricing arrangement. Although the price is already quite good in that it is representative of import

parity for medium-sized cargos, (as opposed to Mali's small market) there is no harm in Mali trying to negotiate a lower posting, for example equal to that of Burkina Faso.

A gradual increase of storage capacities is recommended, mainly in the perspective of the demand growth. As indicated in chapter 2, the total capacity of tanker trucks is not a limiting factor today.

4.16 Niger

The Government of Niger should enter into discussions with the Government of Nigeria to establish an LPG supply agreement, setting out general terms to stabilize the supply from Kaduna and avoid the cut-offs and border closings experienced. The general agreement would be implemented in detail by the operators. It is however not sure that such negotiations be successful due to the relative independence of local authorities, as well as of petroleum products distributors. Thus it is recommended that LPG distribution companies in Niger create new storage capacities, with the support from the government of Niger and from the Regional LPG Program, with a view to reach sufficient levels of permanent stocks, so as to meet the demand in better economic conditions, in case of shortages of supply from Nigeria.

4.2 INVESTMENT PROGRAM

The following planned investments in LPG supply infrastructure were identified in the course of interviews:

4.21 Cape Verde

- Storage additions: SHELL Mindelo, 700 tons, US$ 2.7 million.
- Other: ENACOL Praia, bottling, pumping, miscellaneous US$ 2.0 million.

4.22 Chad

- Storage/bottling additions: TOTAL at Sahr, up-country depot (mini-plant), 25 tons in 2 to 4 years; no investment was specified but should be about US$ 0.2 million. In a second phase TOTAL would anticipate the same installation at Abeché in 5 or 6 years (after the mini-refinery is commissioned).

4.23 Gambia

- Marine receiving depot storage new: FED-BEI, 1,000 tons, range of investment from US$ 1.4 million to US$ 4.0 million (latter figure more credible).
- Storage/bottling new: Amdalaye Enterprises Ltd. 50 tons US$ 0.3 million.

4.24 Mauritania

- Marine receiving facilities - new pipeline to Nouakchott depot after relocation of tanker terminal: US$ 0.4 million.

- Marine receiving depot storage addition: 1,000 tons, US$ 1.6 million, 1992; 500 tons, US$ 1.0 million 1995.

4.25 Niger

- Road tanker 1 x 25 tons, US$ 0.1 million

- Storage addition: Niger Gaz 138 tons, no investment cost provided, estimated at US$ 0.4 million.

4.26 Senegal

- Storage depot and bottling, new - SENGAZ 1,650 tons, US$ 3.5 million.

- Storage depot and bottling, new - SHELL GAZ 1,720 tons, no investment cost provided, should be US$ 4 to 6 million.

4.3 INVESTMENTS OF THE REGIONAL LPG PROGRAM (PRG)

The following are LPG supply infrastructure investments recommended to be supported by the PRG. They all comprise investments which would be made eventually by the operators, and the objective is to advance their installation, by reducing risk to these operators. This being the case the support could be in the form of interest-free loans to the importing/marketing companies.

Considering the current excess of tanker truck capacities, it is suggested to allocate the 455,000 ECU fund (initially foreseen for trucks investments) to the following actions:

- technical assistance to implementing price structures modifications and improvements of the pricing systems,

- financial support to storage and bottling investments, especially in Burkina Faso and Chad.

The contribution of the Regional Gas Program on aspects related to prices, storage and transport is summarized in the part 1 of the report, chapter 4.5.

4.31 Burkina Faso

Provide an additional 200 tons of storage capacity at the SONABHY Bingo depot to increase its capacity to 300 tons and the total BF capacity to 400 tons. Investment US$ 0.6 million. This should permit SONABHY to build up stocks from the most economic source, Tema, and bridge disruptions in this supply, reducing the average acquisition cost.

4.32 Chad

Provide a credit facility to be used by TOTAL and/or SHELL for the installation as soon as possible of an additional 50 tons each of storage in N'Djamena, a total addition of 100 tons, bringing total capacity in the capital to 150 tons. The option for financing of up to 50 tons should be given to each company, with any unexercised amount by one company passing to the other. If the full volume is exercised the total investment would be US$ 0.3 million.

Provide a credit facility to be used by TOTAL and/or SHELL for the installation as soon as possible, of a new 25 ton mini-plant (storage and bottling) each in Sahr. The financing opportunity would be provided to each company on an option basis as above. If the full volume is exercised, total investment would be US$ 0.4 million.

ANNEXES

Annex 1 - Reference costs for investments

Annex 2 - Depot throughput costs

Annex 3 - Depot throughput charge for small landlocked depots, replenished by truck or rail

Annex 4 - Bulk LPG road tankers

Annex 5 - Bulk LPG containers

Annex 6 - CILSS countries - LPG infrastructure
- Burkina Faso,
- Cape Verde,
- Gambia,
- Guinea Bissau,
- Mali,
- Mauritania,
- Niger,
- Senegal,
- Chad.

- ANNEX 1 -

REFERENCE COSTS FOR INVESTMENTS

STORAGE

I. Marine receiving depots - small/intermed size (500 to 10 000 t)

Based on a recent project where a number of marine receiving terminals for LPG in the 500 t. to 2300 t. storage capacity range were configured and estimated to screening study quality, the following relationship was developed IN US$ (1991) :

Investment = 3.0 Million + 2000 x capacity in tonnes.

Example 1 : 500 t. Depot costs : $(3 + \frac{2{,}000 \times 500}{10.000.000}) \, 10^6 = 4.0$ millions

Example 2 : 5000 t. Depot costs : $(3 + \frac{2{,}000 \times 5000}{10.000.000}) \, 10^6 = 13.0$ millions

The basic storage part of the depot was provided using the largest size of "bullet" ("cigare") which is available off-the-shelf, 12 ft. diam x 120 ft. long with a capacity of 175 t. butane. The required capacity is achieved using multiples of this standard size. The all-inclusive installed cost of acquiring and erecting this basic storage is roughly $2000 per tonne, (1991) including some contingency. The $3 million represents an average cost of installations and items other than basic storage and ancillary piping which are not appreciably increased in size as the basic storage is increased from the low to the high end of the size range ; such facilities would include inter alia : marine port/receiving facilities, buildings, land, loading rack, workshop firefighting and safety facilities etc. It should be emphasized that this relationship is order-of magnitude to be used for screening purposes and certain elements such as marine/port facilities and land can vary greatly in scope and cost, depending on the location, topography etc. In order to do a budget quality estimate or better, the specific site details, location and requirements for facilities other than basic storage must be defined.

The relationship shown above is for stand-alone "grass-roots" facilities. If additional, incremental capacity is being added to an existing depot in this size range the cost would be approximately $ 2000 per tonne, without the fixed element. The fixed portion would also be reduced if some of the support facilities are provided from an already existing refinery or depot for conventional petroleum products.

II. Small landlocked depots, replenished by truck or rail

The up-country centres in the coastal countries as well as the landlocked countries are served by depots which receive LPG in bulk road tankers from a main coastal depot. They redistribute to bulk customers using smaller local delivery trucks as well as filling cylinders on-site for distribution to household and commercial customers. Since these distribution centres are usually decentralized near the various urban markets they are sized in accordance with these market concentrations. In addition the truck delivery parcels are small, and the response and flexibility of truck delivery does not usually require large working inventory. Hence total storage size does not have to large and ranges from mini-centres of 25 tonnes up to about 200 tonnes maximum. The complete installation includes :

- basic storage, usually multiples of standard, off-the-shelf bullets in the 25 to 50 t. range.
- bulk receiving and truck loading piping, pumps, rack loading arms.
- cylinder filling facilities
- cylinder testing, sandblasting and painting workshop as well as general maintenance workshop.
- Building(s) for operations, administration.
- Firefighting, safety facilities.

Based on several data points from the field research for this project, plus data from previous studies updated for inflation, a screening quality formula was estimated for the depot size range 25 t. to 200 t.

Depot investment in US$ = 125,000 + 3000 x capacity in tonnes.

Example 1 : 25 t. depot cost : 125,000 + 3,000 x 25 = 200,000 US$

Example 2 : 200 t. depot cost : 125,000 + 3,000 x 200 = 725,000 US$

The same comments as for (I) apply re variability of investment with site location and nature, difficulty and cost of transporting equipment inland from the coast etc. The cost of adding additional storage to an existing depot in this size range would be about $ 3000 per tonne.

- ANNEX 2 -

DEPOT THROUGHPUT COSTS

The largest item in the total cost recovery of building and running a depot is the capital - ROI and capital recovery. The cost of financing inventory can also be significant ; this is a true cost of supplying product but is often not included in commercial depot throughput fee since the product is owned by the person hiring the terminal from a terminal owner. In our case, defining true economic cost of the entire LPG supply system, it is included in the buildup. Other costs are product oss/disappearance, maintenance, operating labour and materials and variable costs such as electricity. The annual capital cost of a new, "grass-roots" depot is in the neighbourhood of 20% of investment. In fact a recommended simplified depot throughput fee formula that has been recently recommended for the inter-company sharing "hospitality" of a large number of old and new depots in Tanzania is 20% of depreciated, revalued assets plus annual operating costs divided by annual throughput. It is obvious under this formula that completely new depots will require a much higher throughput fee than old, depreciated ones. In commercial practice the throughput fees charged by commercial terminal operators are usually closer to pure cash costs of running a depot plus a modest profit margin and do not usually include a high capital item that would reflect the investment cost of a new depot.

The following defines the required throughput fee using the Tanzania model for the case of new depots. The other critical element in the formula which must be defined is the annual throughput or "divisor". A depot if efficiently designed should be sized for the both the maximum tanker parcel size plus a certain number of days of working inventory, plus some security stocks if so desired.

The table below summarizes the results of the full cycle costing of depot throughputs for three different market and depot sizes. Details of the modelling assumptions and results follow.

	Small	Intermed.	Large
Depot throughput (market) vol t/yr	2.000	10.000	50.000
Depot capacity (tonnes)	797	2.186	10.932
Investment ($mio)	4,6	7,4	24,9
Throughput charge ($/t)	528	174	111
of which capital $/tonne	459	147	99

The effect of scale is clearly shown ; also that the capital portion of the total charge is predominant. If the capital is largely depreciated a fee as low as $25 or $30 per tonne for large terminals is sufficient to generate a profit for a large-volume terminal operator. This checks with actual ommercial rates in the $25 to $50 per tonne range for large terminals such as GESTOCI, Abidjan at $35/tonne or the Mauritanian Terminal, $25/tonne ; the Senegal terminal has a charge of some $70 per tonne, still quite a bit lower than full-cycle capital costs as shown above.

LPG MARINE TERMINAL COSTING MODEL

I. Small assumptions

MARKET SIZE, ANNUAL, TONNES	2.000
TANKER PARCEL SIZE, TONNES	500
WORKING PLUS SECURITY STOCKS, DAYS	30
INVENTORY VALUE (FOB + FREIGHT) $/T	500
STORAGE CAPACITY, MAX INVENTORY PLUS	20 %
ROI PLUS CAP RECOVERY	20 %
DEPOT LOSS, DISAPPEARANCE	1,0 %
INTEREST ON INVENTORY p.a.	12 %
DEPOT INVESTMENT, $MILLIONS	3,0 + 0,002 x CAP (tonnes)
OPERATING & MAINTENANCE LABOUR &MISC	0,10 $million/yr
VARIABLE COST ($/T)	1,00
RESULTS :	
MAXIMUM INVENTORY, TONNES	664
AVERAGE INVENTORY, TONNES	414
DEPOT SIZE, TONNES	797
DEPOT INVESTMENT $MILLION	4,6

THROUGHPUT COST SUMMARY :

	$million/yr	$/tonne
ROI + CAP RECOVERY	0,92	459
INVENTORY FINANCE	0,02	12
DEPOT LOSS, DISAPPEARANCE	0,01	5
OPERATING & MAINTENANCE LABOUR &MISC	0,10	50
VARIABLE COST	0,00	1
TOTAL THROUGHPUT COST	1,06	528

II. Intermediate assumptions

MARKET SIZE, ANNUAL, TONNES	10.000
TANKER PARCEL SIZE, TONNES	1.000
WORKING PLUS SECURITY STOCKS, DAYS	30
INVENTORY VALUE (FOB + FREIGHT) $/T	400
STORAGE CAPACITY, MAX INVENTORY PLUS	20 %
ROI PLUS CAP RECOVERY	20 %
DEPOT LOSS, DISAPPEARANCE	1,0 %
INTEREST ON INVENTORY p.a.	12 %
DEPOT INVESTMENT, $MILLIONS	3,0 + 0,002 x CAP (tonnes)
OPERATING & MAINTENANCE LABOUR &MISC	0,15 $million/yr
VARIABLE COST ($/T)	1,00
RESULTS :	
MAXIMUM INVENTORY, TONNES	1.822
AVERAGE INVENTORY, TONNES	1.322
DEPOT SIZE, TONNES	2.186
DEPOT INVESTMENT $MILLION	7,4

THROUGHPUT COST SUMMARY :

	$million/yr	$/tonne
ROI + CAP RECOVERY	1,47	147
INVENTORY FINANCE	0,08	7
DEPOT LOSS, DI1.822SAPPEARANCE	0,04	4
OPERATING & MAINTENANCE LABOUR &MISC	0,15	15
VARIABLE COST	0,01	1
TOTAL THROUGHPUT COST	1,75	174

III. Large assumptions

MARKET SIZE, ANNUAL, TONNES	50.000
TANKER PARCEL SIZE, TONNES	5.000
WORKING PLUS SECURITY STOCKS, DAYS	30
INVENTORY VALUE (FOB + FREIGHT) $/T	300
STORAGE CAPACITY, MAX INVENTORY PLUS	20 %
ROI PLUS CAP RECOVERY	20 %
DEPOT LOSS, DISAPPEARANCE	1,0 %
INTEREST ON INVENTORY p.a.	12 %
DEPOT INVESTMENT, $MILLIONS	3,0 + 0,002 x CAP (tonnes)
OPERATING & MAINTENANCE LABOUR &MISC	0,15 $million/yr
VARIABLE COST ($/T)	1,00
RESULTS :	
MAXIMUM INVENTORY, TONNES	9.110
AVERAGE INVENTORY, TONNES	6.610
DEPOT SIZE, TONNES	10.932
DEPOT INVESTMENT $MILLION	24,9

THROUGHPUT COST SUMMARY :

	$million/yr	$/tonne
ROI + CAP RECOVERY	4,97	99
INVENTORY FINANCE	0,32	5
DEPOT LOSS, DISAPPEARANCE	0,15	3
OPERATING & MAINTENANCE LABOUR &MISC	0,15	3
VARIABLE COST	0,05	1
TOTAL THROUGHPUT COST	5,65	111

- ANNEX 3 -

DEPOT THROUGHPUT CHARGE FOR SMALL LANDLOCKED DEPOTS, REPLENISHED BY TRUCK OR RAIL

The table below summarizes the results of the full cycle costing of depot throughputs for two different market and depot sizes. Details of the modelling assumptions and results follow. This throughput charge would be applicable to the additional cost "add-on" for small bulk customers as well as the capital and operating cost of cylinder-filling facilities ; amortization and replacement/rehabilitation costs of maintaining the stock of cylinders is not included. The depot charge also excludes local delivery cost of transport to bulk customers or stake-truck delivery of cylinders to agents or distributing outlets.

	Small	Large
Depot throughput (market) vol t/yr	250	1.500
Depot capacity (tonnes)	49	196
Investment ($000)	171	713
Throughput charge ($/t)	363	152
of which capital $/tonne	217	95

The effect of scale is clearly shown ; also that the capital portion of the total charge is predominant. If the capital is largely depreciated a fee as low as $70 or $80 per tonne is sufficient to generate a profit for the storage and bottle-filling operator.

INLAND DEPOT, TRUCK-REPLENISHED

I. Small

MARKET SIZE, ANNUAL, TONNES	250
TRUCK PARCEL SIZE, TONNES	20
WORKING PLUS SECURITY STOCKS, DAYS	30
INVENTORY VALUE (FOB + FREIGHT) $/T	700
STORAGE CAPACITY, MAX INVENTORY PLUS	20 %
ROI PLUS CAP RECOVERY	20 %
DEPOT LOSS, DISAPPEARANCE	2,0 %
INTEREST ON INVENTORY p.a.	12 %
DEPOT INVESTMENT, $THOUSANDS	125,0 + 3,0 x CAP (tonnes)
OPERATING & MAINTENANCE LABOUR &MISC	50.000 $/an
VARIABLE COST ($/TONNE)	2,00
RESULTS :	
MAXIMUM INVENTORY, TONNES	41
AVERAGE INVENTORY, TONNES	31
DEPOT SIZE, TONNES	49
DEPOT INVESTMENT $THOUSAND	271,0

THROUGHPUT COST SUMMARY :

	$000/Yr	$/tonne
ROI + CAP RECOVERY	54,19	217
INVENTORY FINANCE	2,57	10
DEPOT LOSS, DISAPPEARANCE	0,70	14
OPERATING & MAINTENANCE LABOUR &MISC	30,00	120
VARIABLE COST	0,10	2
TOTAL THROUGHPUT COST	87,56	363

II. Large

MARKET SIZE, ANNUAL, TONNES	1.500
TRUCK PARCEL SIZE, TONNES	40
WORKING PLUS SECURITY STOCKS, DAYS	30
INVENTORY VALUE (FOB + FREIGHT) $/T	700
STORAGE CAPACITY, MAX INVENTORY PLUS	20 %
ROI PLUS CAP RECOVERY	20 %
DEPOT LOSS, DISAPPEARANCE	2,0 %
INTEREST ON INVENTORY p.a.	12 %
DEPOT INVESTMENT, $THOUSANDS	125,0 + 3,0 x CAP (tonnes)
OPERATING & MAINTENANCE LABOUR &MISC	50.000 $/an
VARIABLE COST ($/TONNE)	2,00
RESULTS :	
MAXIMUM INVENTORY, TONNES	163
AVERAGE INVENTORY, TONNES	143
DEPOT SIZE, TONNES	196
DEPOT INVESTMENT $THOUSAND	713

THROUGHPUT COST SUMMARY :

	$000/Yr	$/tonne
ROI + CAP RECOVERY	142,57	95
INVENTORY FINANCE	12,04	8
DEPOT LOSS, DISAPPEARANCE	0,70	14
OPERATING & MAINTENANCE LABOUR &MISC	50,00	33
VARIABLE COST	0,10	2
TOTAL THROUGHPUT COST	205,40	152

- ANNEX 4 -

BULK LPG ROAD TANKERS

I. Largest tandem : 50,000 litres/25 tonnes

The most common size for long-haul trips from coastal depots to replenish depots up-country or depots in the landlocked countries is the 20 to 25 tonne tandem. A wide range of prices has been quoted for this vehicle type acquired by different West African countries. From US$ 90,000 in Niger to US$ 270,000 in Burkina Faso. Unfortunately a variation in duties paid, freight and whether the vehicle was all-inclusive with tank installed can cause such discrepancies. Most of the private truckers in the region buy second-hand vehicles from Europe at less than half the new cost. A good representative price for such a new vehicle landed in West Africa from Europe, with tank installed and ready to operate is US$ 200,000.

II. Local bulk delivery, 7 to 10 tonnes

There is not much of a reduction in price from the large tandem size to the small local delivery truck due to the extra, specialized fittings and equipment on such a vehicle for control and measurement of deliveries. A representative price for such a vehicle landed in West Africa from Europe would be US$ 150,000.

LPG BULK ROAD TANKER COSTING MODEL -5 YEAR LIFE CYCLE - SAHEL 4TH QUARTER 91

Assumptions

CAPACITY , tonnes	20	
DIESEL CONSUMPTION litres/100km	45	
DIESEL COST FCFA/litre	210	
OPERATING HOURS (34% Util)	14.700	
LOADING + DISCHARGE TIME/TRIP hr	3	
AVERAGE SPEED (kph)	35	
WAGES FCFA/hr	250	
ROI + CAP RECOVERY PER YR	25	%
TRUCK COST 000's FCFA	60.000	
TIRES COST FCFA/km	60	
MAINTENANCE COST FCFA/km	75	
INSURANCE 000's FCFA/yr	1.000	
LIC FEES & TAXES - MALI 000'sFCF	270	
FEES & TAXES TRANSIT 000's FCFA	40	
OVERHEADS + PROFIT % Total Cost	15	%

Costing summary
(thousand FCFA 5 year period)

	1 - WAY TRIP km	
	1.379 km	2.000 km
Number of trips	180	125
FIXED COSTS		
Wages	4.680	4.680
ROI + CR	75.000	75.000
Ins	5.000	5.000
Fees & TC	1.350	1.350
VARIABLE COSTS		
Fuel (95 FCFA/km)	46.837	47.377
Tires (60 FCFA/km)	29.738	30.080
Maintenance (75 FCFA/km)	37.172	37.600
VARIABLE COSTS		
Fees & TC transit (40.000 FCFA/trip	7.188	5.013
OVERHEADS + PROFIT	31.045	30.915
TOTAL 5 YR COST	**238.010**	**237.016**
Tariff FCFA/trip	1.324.439	1.891.061
Tariff FCFA/tonne x km (1 way)	48,0	47,3
Tariff US$/tonne x km (1 way)	0,160	0,158

The results of this tariff model compare with actual road tariffs of $ 0.159/t/km for Abidjan-Bamako in the June 1991 price structure, and $0.205/t/km for Abidjan-Bingo in the latest Burkina price structure.

- ANNEX 5 -

BULK LPG CONTAINERS

Pressurized, modular tanks, of standard size e.g. 6 or 12 tonnes on skids, known as containers are available in the international LPG trade. They are filled at major FOB LPG sources and are convenient for stacking for easy stowage during shipping and for use as bulk storage at the receiving/consuming destination instead of a permanent depot installation. Their principal advantage is that they allow a small, isolated coastal market (e.g. small islands) to be served at low investment/risk to the importer/marketer, cheaper than importing filled cylinders, before it is of the scale that can be served economically by a permanent, fixed marine bulk LPG receiving and storage facility. It can serve a useful purpose in pre-building to a market size which may ultimately justify a bulk terminal. Such a supply mode is not cheap ; high container rental and marine freight, handling and related charges make for an extremely high unit cost ex-container at the market destination. If the market is coastal but continental and can be served by truck from a larger import depot or refinery within reasonable distance it is usually much cheaper than container supply. The following is a typical cost buildup for container supply to Gambia during 1991 :

	US$/tonne
FOB Europe (Anvers)	303
Container Rental (60 days)	210
Marine freight & related charges	529
Onshore transport/handling at dest(Gambia)	13
TOTAL ex-container in Gambia	1.055

If LPG were available into trucks from a large depot or terminal for say $350 per tonne, the total trucking and sub-depot throughput cost would have to exceed $700 per tonne before this mode would be uncompetitive with containers.

Although importers in Gambia are using this mode for supplying customers, it is difficult to understand the economics, versus Senegal supply in bulk by road ; the problem seems to be unreliability of the Senegal supply. Given the size of Gambia's total market at present, 800 tonnes per year, it is doubtful that a "grass-roots" investment in a receiving terminal could be justified versus container supply. Ex-depot cost would be higher than that shown ex-containers. Even if the facility were built very economically by adding on to an existing petroleum products terminal and/or unusually low cost of marine and other non-storage facilities, the total minimum investment in a 1000 tonne facility would have to be $2.5 million, if mostly in pure storage alone. (this is 1/2 of our standard formula value). An ROI and depreciation of 20% on this would alone cost $625 per tonne ; FOB cost, marine freight and other depot throughput costs would have to be added.

- ANNEX 6 -

CILSS COUNTRIES - LPG INFRASTRUCTURE

COUNTRY : **BURKINA FASO** LPG consumption, 1990 : **1.885** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Bingo (near Ouaga) **Bobo Dioulasso**	**SONABHY** **SONABHY**	**1** **1**	**100** **100**	
TOTAL COUNTRY		**2**	**200**	**39**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
10	**20**	**200**	**39**

COUNTRY : **CAPE VERDE** LPG consumption, 1990 : **5.508** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Praïa	**ENACOL**	**1**	**1.500**	
Mindelo	**ENACOL**	**1**	**?**	
Sal	**ENACOL**	**1**	**?**	
Praïa	**SHELL**	**1**	**12**	
Mindelo	**SHELL**	**1**	**150**	
TOTAL COUNTRY		**5**	**1.662**	**110**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
?		**0**	**0**

COUNTRY : **GAMBIA** LPG consumption, 1990 : **800** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Banjul	**M & C**	**1**	**51**	
TOTAL COUNTRY		**1**	**51**	**23**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
2	**8**	**16**	**7**

COUNTRY : **GUINEA BISSAU** LPG consumption, 1990 : **600** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Bissau	**DICOLGAZ**	**1**	**800**	
TOTAL COUNTRY		**1**	**800**	**487**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
?		**0**	**0**

COUNTRY : **MALI** LPG consumption, 1990 : **1.047** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Bamako	**SHELL**	**1**	**63**	
Bamako	**TOTAL**	**1**	**60**	
Mopti	**SHELL**	**1**	**25**	
TOTAL COUNTRY		**3**	**148**	**52**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
5	**22**	**110**	**38**

COUNTRY : **MAURITANIA** LPG consumption, 1990 : **9.035** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Nouadhibou	**Raffinerie ?**	**1**	**4.000**	
Nouadhibou	**SOMAGAZ**	**1**	**150**	
Nouakchott	**SOMAGAZ**	**1**	**1.000**	
TOTAL COUNTRY		**3**	**5.150**	**208**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
?		**0**	**0**

COUNTRY : **NIGER** LPG consumption, 1990 : **560** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Niamey	**NIGERGAZ**	**1**	**63**	
Niamey	**SONIGAZ**	**1**	**32**	
TOTAL COUNTRY		**2**	**95**	**62**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
3	**16**	**48**	**31**

COUNTRY : **SENEGAL** LPG consumption, 1990 : **32.111** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Dakar	**SAR**	**1**	**784**	
Dakar	**SENGAZ**	**1**	**1.100**	
Dakar	**SHELL**	**1**	**1.236**	
Kaolack	**SENGAZ**	**1**	**?**	
Saint Louis	**SENGAZ**	**1**	**?**	
TOTAL COUNTRY		**5**	**3.120**	**35**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
?		**0**	**0**

COUNTRY : **CHAD** LPG consumption, 1990 : **143** tonnes

Storage capacity in distributing/filling depots only (*)

Depot Id and description Location	Owner	Nbr	Capacity Tonnes	d.consump°
Ndjamena	**TOTAL**	**1**	**25**	
Ndjamena	**SHELL**	**1**	**25**	
TOTAL COUNTRY		**2**	**50**	**128**

(*) exclude large-consumer storage

Truck transport capacity (tonnes)

Number	Average size (LPG payload)	Total fleet capacity Tonnes	Days consumption
2	**15**	**30**	**77**