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HAITI: ENERGY EFFICIENCY IN THE SUGAR AND MANUFACTURING INDUSTRIES

Report on a fact-finding visit
conducted between February 27 and March 7, 1985

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Contents

	PAGE	TITLE
LIST OF ACRONYMS		
GLOSSARY		
EXECUTIVE SUMMARY		
INTRODUCTION		
CHAPTER 1	1.1	FINDINGS
	1.1	INSTITUTIONS
	1.3	ENERGY EFFICIENCY IN THE SUGAR INDUSTRY
	1.7	Moulins and Guildives
	1.8	Guildives Only
	1.9	Integrated Moulins-Guildives
	1.10	ENERGY EFFICIENCY IN THE MANUFACTURING INDUSTRIES
CHAPTER 2	2.1	CONCLUSIONS AND RECOMMENDATIONS
	2.2	RECOMMENDATIONS
	2.2	Recommendation 1: Projections of Industrial Energy Needs

	PAGE	TITLE
	2.3	Recommendation 2: Develop Detailed Work Program
	2.3	Recommendation 3: Manufacturing Industries (Other than sugar-cane related)
	2.5	Recommendation 4: Sugar Cane-Related Industries
APPENDIX A		**AGENDA, LIST OF CONTACTS, AND LIST OF DOCUMENTS**
APPENDIX B		**Ed'H ELECTRICITY LOSS REDUCTION PROGRAM**
APPENDIX C		**SUMMARY OF DATA COMPILED ON GUILDIVES**
APPENDIX D		**PLANT VISIT SUMMARY**
APPENDIX E		**PRELIMINARY LIST OF MANUFACTURERS FOR AN ENERGY AUDIT PROGRAM**

Exhibits

Exhibit 1.a	Technical and Financial Assistance Between External Donors and the Ministry of Mines and Energy Resources in the Area of Energy
Exhibit 1.b	Sugar Sickens Free Traders (from March 2, 1985 edition of The Economist)
Exhibit 1.c	Haiti: Energy Balance, 1983 (Thousand toe)

LIST OF ACRONYMS

ADIH	Association des Industries d'Haiti
AFME	Agence Francaise pour la Maitrise de l'Energie
CERIS	Centre d'Etudes et de Recherches sur l'Industrie Sucriere
DARNDR	Direction de l'Agriculture, des Ressources Naturelles et du Genie Rural
Ed'H	Electricite d'Haiti
EPDAC	Energy Policy Development and Conservation Project (AID/Washington)
EPDAC/ECSP	Energy Conservation Services Program of the EPDAC Project (AID/Washington)
ESMAP	Energy Sector Management Assistance Program (World Bank)
IHSI	Institut Haitien de la Statistique et Informatique
ISTI	International Science and Technology Inc.
MMRE	Ministere des Mines et des Ressources Energetiques
PAP	Port-au-Prince
PNUD	Programme des Nations Unies pour le Developpement
WB	World Bank

GLOSSARY

Clairin: the product of the distillation of "vesou" or sugar cane juice used as liquor for local consumption.

Guildives: buy the syrup from the moulins, ferment it, and distill it. The product is "clairin," destined for consumption by the local population. Guildives are similar to moonshiners' stills in the Kentucky Hills used during the prohibition era. Moulins and guildives exist both separately and in combination.

Moulins: mills that use three rollers to press the juice out of the sugar cane stalks. Large industrial sugar cane mills are more sophisticated, but operate on the same principle. Large mills (like Darbonne, Hasco) use multiple rolls, so the cane gets squeezed several times and the residue (bagasse) is reduced to 50-percent moisture. The bagasse can then be used as fuel. In the moulins, the moisture and sugar content of the bagasse are higher, and drying may be necessary before it can be burned. In Cape Verde, the moulins are called "trepiches" and are powered by donkeys. Here, they are usually powered by diesel engines. Moulins also boil down the juice to make "syrup."

Vesou: sugar cane juice.

Zaffra: sugar cane processing period, generally between October and May.

Haiti's energy situation can be characterized by a very high reliance on biomass fuels (i.e., wood, charcoal, and bagasse), which account for 82 percent of total national energy consumption, as well as a rapidly growing demand for commercial energy. Electricity consumption, which is solely constrained by supply, has grown at an average 15 percent per year over the past 10 years and is still projected to increase at an average annual rate of 10 percent over the next 10 years.

Because the extensive use of biomass is already causing severe deforestation and related soil erosion and reservoir sedimentation problems, reforestation programs and programs aiming at increasing the efficiency of use of fuelwood, charcoal, and bagasse are receiving high priority from the government and USAID. Based on a review of work performed in this area by USAID and other institutions including donors, it is recommended that USAID complements its current actions by some very specific programs aiming at reducing the use of, or increasing the efficiency of use of, fuelwood. In addition, USAID should initiate an activity in the area of commercial energy use.

More specifically, it is recommended that USAID undertake a program to help reduce the use of fuelwood in the small distilleries called guildives, which are the most concentrated and intensive users, with an average 2,500 trees burned annually per employee. According to a survey conducted by the Ministry of Mines and Energy Resources under sponsorship from USAID Washington, each guildive consumes 500 to 1,000 tonnes of fuelwood per year, of which probably half is live trees, for an average 2,500 trees per employee and per year. Because more information is needed to identify concrete actions to increase the energy efficiency of the guildives and reduce the amount of wood used, it is recommended first to undertake, with the Ministry of Mines and Energy Resources, a study in a limited number of representative guildives to prepare a detailed work plan. Activities identified in this work plan could include technology development, such as promotion of the use of simple instruments to ensure maximum degree of fermentation

before distillation, and institutional initiatives such as preparation of proposals to increase the level of the integration of guildives to existing moulins and large sugar mills. The World Bank, which recommended such activities in the 1982 UNDP/World Bank joint energy assessment, is interested in co-funding activities in this area.

Second, it is recommended that USAID assist the Ministry and the private sector (e.g., the Association of Industries of Haiti (ADIH)) in projecting industrial energy needs through 1993 (end of the next 5-year plan) and 2000, as it is not clear if Electricite d'Haiti will be able to meet the additional electric demand driven by the expected rapid growth of the assembly export industries.

Finally, to alleviate the problems of future fuel and electricity supply mentioned above, it is recommended that USAID sponsor a modest program of energy audits and subsequent efficiency improvements in the manufacturing sector. Based on experience gained in similar countries and findings of this visit, it is expected that about 15 percent of the commercial energy and fuelwood in this sector could be saved through actions and investments averaging 2 years' payback or less.

Introduction

With a few exceptions, most of the past and current energy-related work in Haiti has focused on supply, with a special -- and justified -- emphasis on wood and charcoal. Little attention has been paid to demand management. Yet, on the basis of experience in other less developed countries (LDCs) and some recent assessment reports conducted on the energy situation in Haiti (e.g., UNDP/World Bank,* MMRE**), the potential for increasing the efficiency of energy use appears to be substantial. Key areas where energy waste can be reduced include the Ed'H distribution system, the sugar industry, other manufacturing industries, and -- to a lesser extent -- the transportation, commercial, and residential sectors.

The 1982 UNDP/WB energy assessment report recommended that the following projects be undertaken:

- Projects with immediate impact:
  - (1.27) reduction of losses and thefts in power distribution
  - (1.28) energy audits in large industrial establishments
  - (1.29) technology changes (e.g., dry process in the cement industry)
  - (1.30) mass transport system
  - (1.32) introduction of efficient stoves.

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*Haiti: Issues and Options in the Energy Sector, June 1982.

**Annual Report, Department of Energy Resources, November 1984.

9

- Other projects:
  - (1.43) more efficient use of bagasse
  - (1.44) national education campaign in the residential/commercial sectors.

With the exception of reducing power distribution losses and thefts, which is being carried out with World Bank assistance, and the more efficient use of bagasse, which has been partially implemented with AFME assistance, these recommendations have yet to be acted on. Of these recommendations, three are likely to produce short-term, tangible results: the reduction of power distribution losses and thefts, energy audits and the subsequent implementation of recommended measures, and the national education campaign.

Work aimed at improving the efficiency of bagasse use is currently focusing on the four large sugar mills. The preliminary results of this work indicate that by implementing technical measures costing about U.S. $5-$10 million per mill, significant excess energy in the form of electricity could be produced and sold to the Ed'H grid. Large amounts of foreign exchange could also be saved. However, the future of the mills themselves is uncertain.*

No reliable balance of bagasse use is available at present, but more than half the total marketed cane -- perhaps as much as 60-65 percent -- is estimated to go to small and medium-sized sugar mills. In contrast to the large mills, most of these smaller operations and their derivatives, such as small distillates, do not burn all the bagasse available to them. Moreover, they often burn scarce wood, for which they pay up to $90 per tonne of oil equivalent (toe). Clearly, increasing the efficiency of bagasse use in operations of all sizes could significantly improve the Haitian energy balance by:

- Generating net electricity from a "free" domestic resource, thus saving imported fuel oil at the margin

*The draft (M. Oliver) of a soon-to-be-published World Bank report titled "Agricultural Sector Study" indicates that there may be reason to scrap the four mills.

- Saving scarce fuelwood
- Disposing of a waste product.

The recommendation to conduct energy audits in the non-sugar industrial sector (World Bank recommendation 1.28) has not yet found a sponsor, but the Ministry of Mines and Energy Resources (MMRE) is putting top priority on this activity. MMRE's interest has increased because of the experience gained and the results achieved in other countries. However, its ability to carry out such an activity is limited, and MMRE views Energy Conservation Services Program sponsored by the United States Agency for International Development (USAID) as the most appropriate assistance vehicle to conduct an industrial energy audit program in the short term.

Recognizing the benefits of efficient energy use, the USAID Office of Energy, which is currently supporting a substantial effort in institutional building and energy planning aimed primarily at MMRE, identified two areas for possible further involvement:

- Reduction of fuelwood use in small and medium-sized cane-using facilities, called moulins and guildives
- Energy efficiency improvements in the industrial sector.

To explore the prospects for undertaking programs in these two areas, USAID Washington asked Hagler, Bailly & Company to conduct a short fact-finding visit in Haiti. The mission was carried out by Alain Streicher, vice president, between February 27 and March 7, 1985, when the new USAID mission Action Plan was being prepared. During the preparation, several energy issues were discussed, including the availability of power to supply the rapidly developing assembly-line industry. Because electricity saved through conservation activities can be made available at minimum capital cost to serve the assembly-line industry, the scope of work was extended to this industry.

This report first presents the visit findings (Chapter 1) and then the conclusions and recommendations (Chapter 2).

11

A detailed agenda, list of contacts, and sources of literature reviewed are presented in Appendix A. Four other appendices are provided to support the analysis.

12

1 FINDINGS

This chapter presents the visit findings, focusing first on institutions involved with energy efficiency to provide a context for industrial sector activities, and then discussing the status of energy use in the sugar and other manufacturing industries.

INSTITUTIONS

The major institutions concerned with energy efficiency are the Ministry of Mines and Energy Resources, the Ministry of Agriculture and Rural Development, the Secretariat of Industry, Electricite d'Haiti, the chamber of industries -- called "Association des Industries d'Haiti" or ADIH -- and donor agencies.

The Ministry of Mines and Energy Resources (MMRE in French) has overall responsibility for coordinating energy efficiency activities in all sectors and developing a national institutional capability for energy planning. MMRE is currently assisted in this task by USAID, which has provided a full-time senior advisor since May 1984 to assist MMRE staff in energy planning. The energy division of MMRE is headed by a senior geologist, Wilfrid St. Jean, and has a staff of 18, consisting mainly of geologists and engineers. Current capability in energy demand management and planning is still limited, especially in economic and financial analysis and long-term planning. Based on the interviews conducted during the mission, no other organization appears to dispute the central role in energy planning assigned to MMRE and the ministry benefits from a good image.

MMRE's current work plan calls for it to carry out the following industrial energy efficiency activities:

> "Pursuing conservation activities undertaken with AFME assistance in the area of large sugar mills, small, and medium distillers and modern and traditional 'moulins.'

With respect to the large sugar mills, MMRE will conduct a feasibility study on generating power from excess bagasse in the Sucriere du Nord and at Darbonne.

As far as small distilleries [which use a large quantity of bagasse] are concerned, a small bagasse compactor is expected to be installed to [create a large bagasse supply and] promote the use of this fuel in commercial and industrial applications (e.g., bakeries, dry cleaning, essential oils)."*

The Ministry of Agriculture and Rural Development (DARNDR) has overall responsibility for implementing agricultural policy (see World Bank/UNDP energy assessment report), with the noticeable exception of fixing prices, which is the responsibility of the Ministry of Economy, Finance, and Industry. Mr. Flambert, the current DARNDR minister, formerly managed the newly commissioned sugar mill of Darbonne, and he is regarded as a top expert on cane sugar matters. It was, unfortunately, impossible to meet with him during the in-country visit.

The Secretariat of Industry, which answers to the Ministry of Economy, Finance, and Industry, has overall authority for industrial policy. During an interview, M. Bernard Fatton, the secretary, expressed interest in an energy conservation program and offered full support to such an initiative. He personally arranged several of the plant visits.

Electricite d'Haiti (Ed'H) is extremely accessible compared with similar operations elsewhere in Africa and Central America. Ed'H is currently implementing, with World Bank assistance, a major distribution loss reduction project (see Appendix B for details on this project). Ed'H is also very aware of energy efficiency in power generation, and is currently operating recently installed and highly efficient diesel engines. In addition, Ed'H is interested in participating actively in an energy conservation program because it would alleviate some of the supply-related problems caused by an annual rise of 10-12 percent in demand and rapid

*Source: MMRE 1984 Annual Report, page 14. Translated from French.

sedimentation of the major hydroelectric dam (Peligre). Ed'H would even consider loaning some of its engineers for energy auditing.

Association de Industries d'Haiti (ADIH) appears to be more concerned about future availability of electric power to the booming assembly-line industry than about conservation per se. ADIH's director was nevertheless very cooperative and developed a tentative list of candidate plants to be contacted for energy audits.

Donor agencies. Only the French and German bilateral aid organizations are currently conducting industrial energy efficiency projects. Since 1983, France's AFME has used the services of CERIS, a private French sugar research institute, to conduct a series of studies on the status of energy use efficiency in large sugar mills and traditional moulins and guildives. According to preliminary conclusions, large sugar mills could become net energy (electricity) producers with the investment of about U.S. $5-$7 million per mill. This investment would cover process modifications needed to maximize the benefits of burning excess bagasse and using coal between the sugar cane processing seasons (called zaffras). Expected internal rates of return are about 25 percent before taxes. With respect to the moulins and guildives, preliminary reports and extensive discussions with CERIS specialist M. Joseph Olivier have identified two priority areas: compacting excess bagasse to serve conventional fuelwood markets and integrating moulins and guildives.

German bilateral aid also focuses on conditioning waste from agroindustries such as vetiver roots, cotton waste, and sawduts -- either by briquetting or compacting -- to be used as fuel, displacing fuelwood in those industries and other markets (e.g., laundries, dry cleaners, school canteens). Indeed, agroindustries are believed to be large fuelwood users, although there has not been any detailed survey of fuelwood use in these industries yet.

A summary of donor energy-related activities is provided in Exhibit 1.a.

ENERGY EFFICIENCY IN THE SUGAR INDUSTRY

Based on an extensive review of existing literature (see Appendix A) and interviews conducted with USAID/

15

Exhibit 1.a

Technical and Financial Assistance Provided by External Donors to the Ministry of Mines and Energy Resources in the Area of Energy

	Area				
Donor	Energy planning	Conservation	Renewables	New sources	Basic research
USAID	Technical and administrative support Staff training (signed agreement)	Study of fuel use (fuelwood and others) in small industry and commercial activities such as moulins, guildives, essential oils, bakeries, etc. (study in progress)		Technical and economic study for the use of Maissade lignite briquettes (under discussion)	
AFME	Definition of regional policies for fuel wood (being negotiated)	Study of bagasse utilization at Sucreries Darbonne and Nord (study in progress) (letter of intent)	Installation of a pilot compactor in a traditional moulin Photovoltaic pumps and lighting for dispensaries (letter of intent)		
IDB					Technical support Mineral and energy resource geology Staff training (signed agreement)
OLADE	Technical assistance for updating national energy balances (telex of interest)				
World Bank		Improvement of coal use in households (study in progress) (signed agreement)	Rural Energy Development (in negotiation)		

SOURCE: MMRE.

PAP, MMRE, consultants, and the AFME/CERIS team, the state of the sugar-cane related industry can be summarized as follows:

The four large sugar mills -- HASCO, Dessalines (also called "Les Cayes"), Usine Sucriere du Nord (also called Caldos), and Darbonne -- are technically, economically, and financially inefficient and cannot compete on the world market. This inefficiency can be illustrated by comparing the guaranteed sale price on the domestic market (US $0.34/lb) with the ceiling price guaranteed by the European Economic Community (US $0.215/lb), taking into account competitive cane and labor prices. In late February 1985, the free international market price of sugar fell below ¢3.5/lb (see Exhibit 1.b)! Although the value added at the mill is large and should ensure record profitability, such is not the case. There are several reasons for the mills' inefficiency: low cane sugar content, government price regulations, mill age,* technology, operating factor, and land tenure. Most sugar specialists, particularly at the World Bank, have concluded that most -- if not all -- of the mills should be shut down. Others believe that "eliminating" the small operations (moulins and guildives -- M&G) would largely solve the problem by enabling the large mills to operate at higher capacity factors and perhaps using cane with a higher sugar content.

The low sugar content of Haiti's cane** contributes to the problem of energy inefficiency. While most mills are self sufficient for thermal energy needs by burning the bagasse they produce, they use oil to supply all or part of their power needs. Only Darbonne has the potential of being totally self sufficient for its mill operations. The three other mills need to use some oil for the mill operations themselves and also for running the irrigation pumps they own. (Some mills, e.g., HASCO, control a portion of their cane supply and have to

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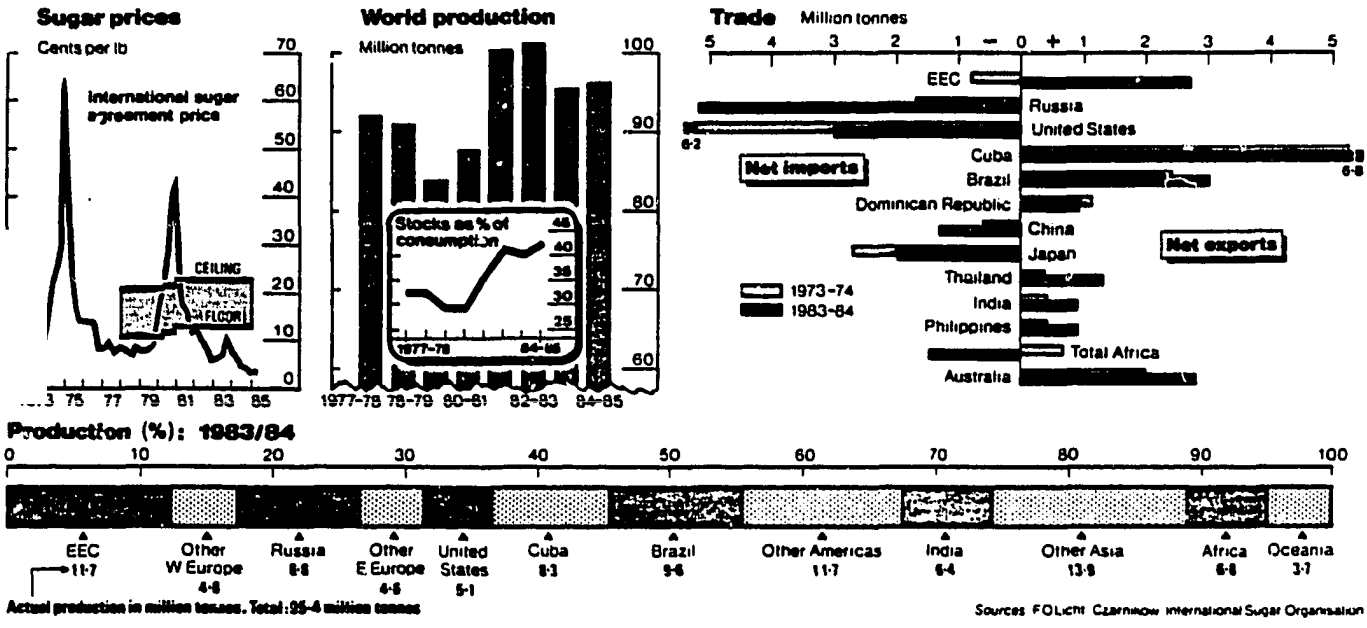
*Two mills out of the four are more than 35 years of age; the third one is more than 15 years of age. Only Darbonne is a very recent sugar mill (1983.)

**For example, average sugar content in the north plains was 3.7 percent versus an international standard of 10-12 percent. Source: Delatour, table VIII. See Appendix A for detailed reference.

Sugar sickens free traders



[illegible]e-market price of sugar fell below 3½ cents a lb this week. That is less [illegible]ne third of the most efficient sugar-producing countries' production. Yet it is quite likely that prices will remain below production costs [illegible]ars to come—even with world sugar consumption growing at 2% [illegible]lly.

The world sugar market makes a nonsense of economic theories. It is a tangled mess of trade restrictions, price subsidies and quotas. The result is that the world market price is almost meaningless, and producer profits (and losses) depend more on who a country's friends are than how efficient it is.

[illegible]rld's most widely [illegible]modities. Nearly [illegible]will be produced [illegible]onnes of that will [illegible]lly, the rest sold [illegible]a percentage of [illegible]re widely traded [illegible]which is sold in [illegible]e world wheat [illegible]of the condition [illegible]of sugar is not. [illegible]mber of produc[illegible]er 100 countries [illegible]st, only five ex[illegible]ree quarters of [illegible]or most produc[illegible]ome markets are [illegible]on for growing the stuff. [illegible]ance, grows 6.4m tonnes [illegible]nly 1m. Countries export [illegible]oduction—and marginal [illegible]er than average ones. So [illegible]lb is not a strong disincentive for many producers.

Still, market forces would operate [illegible]ore powerfully were it not that about [illegible]e third of all internationally-traded [illegible]gar is not sold at world prices at all. The three main sugar-importing regions each build protective walls around their domestic markets and guarantee client suppliers fixed shares at fixed prices. About 9m tonnes a year of sugar is traded in this way between:

● **Cuba and Comecon.** Cuba is the world's biggest sugar exporter. In 1984, it shipped nearly 7m tonnes abroad. About 4m tonnes of that went to Russia under a long-term agreement; another 500,000 tonnes went to other members of Comecon in eastern Europe and a further 750,000 tonnes was shipped to China. The Russians pay not in cash but in tractors, doctors and instruments of foreign policy like guns. But by any standard, the deal is a good one for the Cubans: the value of the goods works out around 50 cents per lb of sugar.

● **The EEC and developing countries.** The European common market allows a fixed amount of sugar to be imported into the common market from so-called ACP (Africa, Caribbean and Pacific) countries. This year the limit is nearly 1.4m tonnes, four fifths of which goes to Britain. The countries get paid 21 cents a lb for their exports, six times the current world market price. This arrangement looks like a godsend to the countries which have the biggest quotas under the scheme: Mauritius, which sells 530,000 tonnes of its annual 640,000-tonne harvest, and Fiji, which has a quota of 178,000 tonnes, 62% of last year's blighted harvest. In fact, the EEC's sugar regime has done more than anything else to wreck the world sugar market.

Subsidised domestic prices are such a great incentive to overproduce that they have turned the EEC from a net importer of nearly 1m tonnes in 1973 into the world's second biggest exporter of sugar. It exported 5.4m tonnes last year, all of it dumped.

● **America and its allies.** Like the common market, America also maintains an import quota, of 2.4m tonnes in the 13 months to next December. It pays foreign suppliers the same price—17¾ cents a lb—that it gives its own producers. The difference, however, is that producers' costs are so high in the United States that even 17¾ cents a lb is not a big enough incentive to overproduce.

Countries which produce far more sugar than they consume and which do not benefit from one quota or another are the big losers in this game of subsidies: Australia, Thailand and South Africa most of all. Australia produces 3.5m tonnes a year; domestic consumption is 700,000 tonnes; 190,000 tonnes go to America. Fortunately, it is one of the world's most efficient producers. Even so, in Queensland, the main sugar producing state, the farmers' union reckons one farmer in 10 could be driven out of business this year.

Everybody suffers in the end. Markets dominated by quotas and subsidies provide no incentives to efficient production. That leaves markets vulnerable to disruption. Crop failures in a couple of key producing countries send prices spiralling every six or eight years. The last time this happened was in 1980. With sugar stocks now at two fifths of annual consumption, that price shock will take longer than usual, but it will come.

purchase diesel oil to run the irrigation pumps.) They are, therefore, net importers of commercial energy when they could be net exporters. The current AFME-sponsored assistance program is tackling this problem with CERIS expertise. Modifying Darbonne and Citadelle to make then net producers of electricity appears to be both technically feasible and financially attractive. In addition, the use of coal during the inter-zaffra period would mean large foreign exchange savings to Haiti.

Moulins and Guildives

Until recently, little was known about the role of small moulins and guildives (M&G) in the Haitian economy. Since 1983, however, two ongoing efforts have shed some light on the subject: The Report on Energy Consumption in Moulins and Guildives prepared by Margaret Barkley et. al. for MMRE under USAID sponsorship, and a series of reports prepared by Mr. Olivier for AFME on energy use in small M&G.*

The MMRE report is based on an extensive survey conducted by the Ministry in 1984 (see Appendix C) and for the first time provides statistical information on six different types of M&G:

1. Traditional guildives only
2. Modern guildives only
3. Traditional moulins only
4. Modern moulins only
5. Combined guildives and moulins -- modern
6. Combined guildives and moulins -- traditional.

Data gathered and analyzed from a representative sample of 70 moulins and guildives (there are an estimated 461 guildives operating in Haiti), included: production capacity, measured in PC -- or points de chaudiere** -- for guildives and in tonnes per day for moulins; geographic distribution; type of heating system (direct or

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*Etude de l'utilisation de la bagasse dans les guildives en Haiti, J. Olivier. CERIS, September 1983.

**One PC is the capacity of a guildive which can produce about one 55 gallon drum of clairin (alcohol for local consumption) a day.

steam); weekly physical inputs (including fuelwood) and outputs; capacity utilization; efficiency of production (yields); input prices (including fuelwood); unit cost of production by component (raw materials, labor, fuelwood, and others); revenue-to-cost ratios and energy inputs (fuelwood, electricity, fuel oil, and kerosene). Preliminary results are provided for two categories of M&G: guildives only and integrated guildives-moulins. Although these results are being finalized,* the energy-related findings are summarized below.

Guildives Only**

Wood is the predominant energy source. Bagasse is not used, and consumption of commercial fuels is negligible. On average, the separate guildives consume 8.2 tonnes of wood per week to produce about 20 drums (1,100 gallons),*** which is roughly equivalent to 19.7 cubic meters of stacked wood or 11.3 cubic meters of solid wood. It takes approximately 20 four-inch diameter trees to make one cubic meter of solid wood. Average weekly consumption **per guildive** in this guildive-only category is equivalent to 226 four-inch diameter trees. Thus, the equivalent of about 5 million trees -- a large part of the wood is actually dead wood -- used annually, or 140,000 tonnes in all of Haiti's guildives.****

Wood use efficiency varies considerably by region and size of guildive. For example, the largest guildives are four times more efficient than the smallest and the guildives in Leogane near Port-au-Prince are six times more efficient than the least efficient guildives in St. Marc, about 100 kilometers north of Port-au-Prince. These variations may indicate that there are potential

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*Final report should be available by mid-April 1985.

**Selected excerpts from report cited above.

***Average between 16 and 25 drums, depending on the size and location. Source: MMRE AND CERIS.

****These figures, given in page 23 of the draft report, seem to be in contradiction with other figures given on page 27. According to the latter, each guildive consumes the equivalent of 30,000 trees per year.

20

technological limitations on the level of efficiency of wood use that can be achieved in the smaller guildives. The fact that unit wood costs decrease as size increases, despite increases in the price of wood as size increases, also shows that size is a major variable in determining wood use efficiency.

Wood prices also vary significantly across regions. Wood is most expensive in Leogane, and clairin producers in Leogane use wood more efficiently than in the other regions. However, the high inputs of wood per drum of clairin in St. Marc are not explained by a significantly lower price of wood in that area.

Integrated Moulins-Guildives

In the moulin-guildive group, there are two types of guildives -- those that heat the fermented juice (called vesou) directly and those using a steam heat transfer system. The direct heat guildives burn both wood and bagasse, while the steam heat transfer guildives burn only bagasse. The largest guildives burn no wood at all, relying entirely on bagasse to run the steam system.

In the integrated moulins-guildives, commercial energy plays a much greater role than in the guildives only, because of the additional source of power needed for the cane crushers. The total weekly expenditures on energy are thus much greater than those on wood alone. The Les Cayes guildives in the south and the guildives of the north spend approximately the same amount on commercial energy per week, while the guildives of St. Marc spend much less, mainly because there are water-powered sugar cane mills in St. Marc.

An integrated moulin-guildive burns between 6.5 and 14 tonnes of bagasse per week to produce 16-25 drums of clairin, depending on its size and the location; Les Cayes consumes significantly more than any other region. Average annual consumption is estimated at 198.6 tonnes of wood and 358.4 tonnes of bagasse per M&G, demonstrating that the integration of moulins and guildives is the single most attractive option for saving wood (200 tonnes consumed per year versus more than 1,000 tonnes per year per guildive).

In the CERIS study, J. Olivier concludes that the energy use in guildives and moulins is very inefficient,

and he makes two recommendations. **First**, he recommends that the operations of moulins and guildives be integrated as much as possible to produce the clairin directly from the cane juice rather than from syrup, reducing the heat (and fuel) requirement by a factor of almost two. As a result, he estimates that 174 kilograms of bagasse with a 50-percent moisture content would be made available for each tonne of cane crushed.* **Second**, he recommends that a press for compacting bagasse be installed for demonstration purposes, to make excess bagasse "marketable" outside the sector (e.g., laundries, canteens, other agroindustries).

ENERGY EFFICIENCY IN THE MANUFACTURING INDUSTRIES

The manufacturing sector in Haiti consists mainly of sugar industries, other agroindustries, cement, steel, textiles, and more recently, assembly line industries. Today, the assembly-line export industries (clothing, baseballs, electrical and electronic equipment) employ about 60,000 people, or more than half of all manpower in the manufacturing sector.

Manufacturing industries, other than the sugar industry, consume about 26 percent of all energy and 36 percent of all commercial energy. According to the latest energy balances developed by MMRE and its AID consultant, these industries consumed 317,000 toe in 1983, of which fuelwood accounted for an estimated 213,000 toe (two-thirds); petroleum products, 45,000 toe (14 percent); coal, 35,000 toe (11 percent); electricity, 4.5 percent;** and bagasse, 3.5 percent (see Exhibit 1.c). Of course, the fuelwood consumption estimate is approximate, as no detailed survey has been conducted. Nonetheless, such a level of consumption corresponds to several million trees burned annually. While it is not known exactly where and why such a large quantity of fuelwood is burned, one can roughly estimate that the

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*Extrapolated nationwide, roughly 20,000 toe of wood or petroleum products could be saved annually for a foreign exchange saving of up to $4 million per year.

**If accounted for in primary energy equivalent, however, electricity consumption would represent about 13 percent of total energy consumed.

22

Exhibit 1.c

Haiti: Energy Balance, 1983
(Thousand toe)

Type of energy	Households	Commerce services	Transport		Public sector	Agriculture*	Sugar	Steel	A	Cement	Flour mill	Non-energy petroleum	Total demand
			Road	Air									
Electricity	11.10								13.90				25.00
Gasoline			44.02	1.36									45.38
Diesel			53.41				3.61	0.08	18.28	2.85	3.82		82.04
Fuel oil							1.12	1.41	9.82	6.68			19.02
Kerosene	0.13	11.79		11.82			0.01		1.30				25.04
Imported coal										35.50			35.50
Charcoal	37.10	27.50											64.60
Wood	429.70	214.90							213.20				857.80
Bagasse							50.60		10.00				60.60
LPG	1.50	1.60							0.60				3.70
Non-energy												2.00	2.00
Animal													0.00
Human													0.00
Total	479.53	255.79	97.43	13.18	0.00	0.00	55.33	1.49	267.09	45.03	3.82	2.00	1,220.68

*Excluding sugar.

SOURCE: MMRE.

major users are the guildives and agroindustries (essential oils).

Based on a site visit to four major industries (cement, flour, steel, and beer) that account for about half of all commercial energy consumption in the manufacturing sector, it was found that:

- The large industrial energy-consuming plants are relatively new (10 years old, on average)
- Specific energy consumption (i.e., the quantity of energy used to produce one unit of final product) is about 10-20 percent above international standards; this percentage represents a first approximation of the conservation potential
- Projects to achieve energy savings are easy to identify and involve proven technologies (heat exchangers at the steel mill, steam system revamping at the brewery, power factor improvement devices at the flour mill, and insulation at the cement kiln)
- Because domestic commercial energy prices are at or above international prices, paybacks for implementing such projects are likely to be very short
- Industry itself, AHDI, and Ed'H are eager to cooperate in a national industrial energy conservation program
- Institutional barriers appear to be minimal, except for some state-owned companies for which the government sets prices.

Details on these plant visits are provided in Appendix D.

Although no detailed data on energy consumption at the plant level are available, a preliminary review of potentially large energy users (i.e., those with annual energy bills greater than U.S. $50,000) conducted with ADIH during the visit indicated that about 30 plants could be considered "large" energy users. These plants are listed in Appendix E.

The growth of the manufacturing sector -- and therefore of energy demand -- is expected to be driven by the continuing development of the assembly-line export industries. According to several officials interviewed in-country, the availability of power is a prime concern, and it is not clear if Ed'H will be able to meet this increased demand under its current expansion plan.

An assembly-line industry employing 250-500 people in non-energy-intensive activities (e.g., sewing) is generally expected to consume about 200 watts per hour per employee, which translates into a total average hourly demand of 50-100 kW. Average annual electricity consumption in a two shift/five-day operating mode would be 200,000-400,000 kWh. Under the Caribbean Basin Initiative, ADIH expects the creation of 250,000-500,000 jobs or 1,000 basic assembly units by 2000. Although these targets may be overly optimistic, it is useful to compare them in terms of energy demand to projected supply.

The additional power needed for their activities would be around 100 MW and 200-400 GWh per year, while total Ed'H projected capacity would be around 400 MW and 1,500 GWh per year.*

Up to one-fourth of total installed power production and capacity could be needed for this one subsector. Again, while these numbers are high, they show that a large surge in one electricity-intensive activity would probably have to be met (as in the case of cement and flour) by dedicated diesel generating sets. If only half of the needs could be met by diesel power, up to 60,000 tonnes of diesel oil worth about $13 million annually would be needed.

*Source: Extrapolated from current Ed'H projection to 1993, using a 9-percent annual rate of increase.

25

2 CONCLUSIONS AND RECOMMENDATIONS

Despite the recent shutdown of major industrial fuel users, such as Reynolds Bauxite and the conversion of the cement plant from oil to imported coal, industry remains a key target for energy savings. One of the salient characteristics of the energy use in this sector is, according to published sources, the predominant consumption of fuelwood. Yet, no one knows with certainty how much, where, how, and why so much wood is used.

Work on improving energy efficiency in the larger sugar mills is well under way. It is being properly coordinated with the national authorities (MMRE, Agriculture, and EDH), has been undertaken by well-qualified people, and appears to be under control. Consequently, there is no significant role for AID, particularly given the risk of undertaking a major effort in an industry that is condemned to remain non-competitive for years to come.

In the M&G operation, on the other hand, the activities of other donor organizations are spotty. AID/MMRE's survey provides a good starting point to determine further work for AID in this area. However, so little is known about M&G operations that it is difficult to identify program actions with precision. For example, the following key questions remain unanswered:

- What is the future of the M&G plants under various scenarios of operation for the large sugar mills (e.g., one, two, or three shut down, the government intervenes to increase cane prices so much that the large mills can run at higher capacity)?

- Why are some guildives of similar size and using similar processes consuming drastically different amounts of fuelwood?

- Why are so few M&G integrated, when integration can provide substantial economies?

- Why do some guildives persist in using fuelwood (for which they pay $10-$30 per tonne) when they could use much cheaper bagasse?

- Why does the alcohol content of the fermented juice vary by 20-30 percent in similar guildives?

The only energy-related project for M&G, conducted under French assistance, entails the installation of a compactor or "press". The bagasse, measuring 2 feet by 1 foot by 1 foot, will be sold on the marketplace to guildives and small industrial and commercial facilities. While this idea may prove successful in the medium term, it will not solve all aspects of the broader problem of the future of these traditional industries. It remains that guildives are likely to continue to be large users of fuelwood if no major program is undertaken to change this pattern of fuel consumption. The problem would be even more acute if the government takes action against the small moulins to protect the large sugar mills from their competition. In such a situation, no guildive would be able to use any bagasse, and would have to rely exclusively on fuelwood or commercial fuels.

With respect to other manufacturing activities, there is (1) a significant potential for savings and (2) a general willingness on the part of all parties-at-interest to cooperate in an energy efficiency improvement program, but there is also (3) a lack of knowledge and expertise, which explains why such improvements have not been made before. Therefore, this area is clearly appropriate for AID technical assistance.

RECOMMENDATIONS

Recommendation 1: Projections of Industrial Energy Needs

- MMRE should receive assistance to project industrial energy need by fuel type and industry through 1993 and 2000.

- Level of effort: 1.5 man-months.

- Cost: $20,000.

- Proposed funding: EPDAC/ECSP.

Justification: MMRE should be assisted immediately, as part of the energy sector component of next 5-year plan now in preparation, to project industrial energy needs through 1993 and 2000 for two reasons. First, Ed'H may not be able to meet additional power demand from the fast growing assembly-line export industry, for which ADIH has recently been requested to provide an estimate for 1993 and 2000. Second, it is unclear what energy demand by fuel type will be for the industrial sector as a whole, and what impact the structural changes (e.g., future of the sugar industry, assembly export industry) will have on this projection. Of particular interest will be the projected demand for fuelwood.

Recommendation 2: Develop Detailed Work Program for Improved Energy Efficiency in Industry

A two-member team should be sent to Haiti to (1) discuss recommendations 1, 3, and 4 with USAID/Haiti, MMRE, ADIH, EdH, DARNDR, and other interested institutions, (2) finalize the detailed scope of work for implementing these recommendations, and (3) propose detailed implementation arrangements (e.g., funding, profile of consultants, optimum schedule, role of counterparts).

Cost: $15,000.

Funding: EPDAC/ECSP (AID Washington).

The preliminary analysis carried out during the short-term visit indicated that the following two activities may warrant being part of this detailed work plan:

- Energy audits in non-sugar manufacturing industries
- Study of reduction of fuelwood use in guildives.

Recommendation 3: Manufacturing Industries (Other than sugar-cane related)

- With ECSP assistance, start an integrated energy conservation program in 20-25 medium and large plants (i.e., those consuming more than 300 toe/year). The program should include:

- information/awareness
- training
- audits
- project evaluation of proposed conservation projects
- possible assistance in implementation of projects.

- Period: September 1985-September 1986.
- Cost: $75,000 (technical assistance only).
- Information training and audits to be co-funded by EPDAC/ECSP (AID Washington) and USAID Haiti.

Justification: The 20-25 plants probably consume more than two-thirds of the commercial energy used in the industrial sector and a significant fraction of the fuelwood. Based on experience gained elsewhere, and assuming that this group consumes 70,000 toe of commercial energy, up to 10,000 toe -- worth up to U.S. $2 million in foreign exchange -- could be saved annually. This figure compares with a one-time cost of:

Technical assistance (Audits, surveys, and training)	= $ 75,000
Feasibility and engineering studies	= $ 400,000
Equipment	= $3,000,000
Total	= $3,475,000,
	rounded to $3.5 million.

At this point in time, it is not clear where the money for implementing the recommended energy saving projects would come from. Local private banks and the World Bank are prime candidates but have not been interviewed to find out if they are interested. AID's role would be limited to fund the technical assistance and leverage other funding sources.

This activity would parallel other AID-sponsored activities aimed at the industrial sector, such as assessment of the potential for replacing fuelwood with other fuels, such as lignite briquettes.

Recommendation 4: Sugar Cane-Related Industries

- The scope of action should be aimed at limiting the use of fuelwood in the guildives. To reach this goal, AID assistance should first aim at working in close collaboration with MMRE's counterparts to develop sufficient understanding of technical, social, and economic characteristics of M&G operations to be able to identify and design subsequent technical assistance programs.

- Examples of concrete projects could include:

  - Integration of guildives with existing separate moulins

  - Distribution at low cost of appropriate instruments to measure the level of vesou fermentation with ± 2 percent accuracy (high degrees of fermentation translate into high fuel efficiency because, for a given amount of heat given to the fermented vesou, more is used to heat alcohol)

  - Improved combustion efficiency.

- Level of effort: 9 man-months.

- Cost: $75,000-$100,000, including implementation of selected programs.

- To be co-funded by EPDAC/ECSP (AID Washington), USAIL Haiti, and perhaps the World Bank, which has indicated a strong interest in participating in such an effort.

Justification: One of the major components of USAID assistance to Haiti in the area of energy, agriculture, and natural resources seeks to reverse the dramatic deforestation trend in the country. Because most of the wood is used as fuel in dispersed applications such as households, concentrated uses of wood are key targets. On a per capita basis, wood use is most intensive in guildives, where an estimated 2,000 people (direct labor) burn the equivalent of about 5 million trees a year or 2,500 trees per worker. A program aimed at reducing wood use by 50 percent appear to be technically feasible and would offer the following benefits:

= 2.5 million trees saved annually

= 70,000 tonnes of wood saved annually

= 20,000 tonnes of oil equivalent saved annually

= 10 percent of the fuelwood used in industry saved annually.

AGENDA AND CONTACTS

Wednesday, 2/27/85

2:00 p.m. -- Arrival in Haiti

3:30 p.m. -- Meeting with Pamela Baldwin, ST/EY; Thomas Wilbanks, ORNL; Lou O'Connor, USAID/Port-au-Prince Energy Officer; Clarence Kooi, ITSI Resident Advisor

Thursday, 2/28/85

9:00 a.m. -- Meeting at USAID about energy strategy

11:00 a.m. -- Meeting with John Lewis, USAID/PAP, Agriculture Specialist

11:30 a.m. -- Meeting with Jim Walker, USAID/PAP, Economist

12:30 p.m. -- Lunch with mission member and Lou O'Connor

2:00 p.m. -- Meeting with Margaret Barkley, Consultant to MMRE

4:00 p.m. -- Meeting with energy strategy working team and Wilfrid St. Jean (MMRE)

Friday, 3/1/85

8:30 a.m. -- Meeting with Wendy King, USAID/PAP, Agroforestry Project

9:30 a.m. -- Meeting with Jim Walker

12:00 p.m. -- Meeting with Michel Simon, Directeur General, MMRE

1:00 p.m. -- Roundtable about training at MMRE, with Pamela Baldwin, Clarence Kooi, Wilfrid St. Jean, Thomas Wilbanks, and Claude Delphin (MMRE)

2:00 p.m. -- Second meeting with Margaret Barkley

5:00 p.m. -- Meeting with Chris Julliard, USAID/PAP, Private enterprise development

Saturday, 3/2/85

9:00 a.m. -- Meeting with Loctamard Antilus, MMRE

10:00 a.m. -- Visit of moulins and guildives in the Leogane Valley

11:00 a.m. -- Meeting with M. Eddy Azael, private moulin/guildive owner and operator

2:30 p.m. -- Return to PAP; report reading

Sunday, 3/3/85

11:00 a.m. -- Meeting with Clarence Kooi; afternoon -- report reading, review of strategy paper

9:00 p.m. -- Meeting with Yves Chevalier, AFME

Monday, 3/4/85

8:00 a.m. -- Meeting with Bernard Falton, Secretaire d'Etat a l'Industrie

9:30 a.m. -- Meeting at MMRE

10:30 a.m. -- Meeting with M.M. Violant and Haver-Acierie d'Haiti

12:30 p.m.-- Meeting with Clarence Kooi

2:00 p.m. -- Meeting with W. M. Robinson and Patricia Tournier, Brasserie Nationale d'Haiti S.A.

3:30 p.m. -- Second meeting with Chris Julliard

6:00 p.m. -- Second meeting with Lockmard Antilus

8:00 p.m. -- First meeting with M.M. Joseph Olivier, CERIS; and Yves Chevalier

Tuesday, 3/5/85

7:00 a.m. -- Second meeting with J. Olivier

8:30 a.m. -- Meeting at MMRE

10:30 a.m. -- Meeting with Carmelo A. Daidone, Le Cement d'Haiti S.A.M.

1:00 p.m. -- Meeting with M. Dietz and Fernandez, La Minoterie d'Haiti

2:30 p.m. -- Third meeting with Margaret Barkley

4:00 p.m. -- Meeting with M. Chancy, Consultant, LGL

6:00 p.m. -- Third meeting with MM. Olivier and Chevalier

Wednesday, 3/6/85

7:00 a.m. -- Fourth meeting with MM. Olivier and Chevalier

10:00 a.m. -- Visit to Institut National de la Statistique et Informatique

11:30 a.m. -- Meeting with M. Levy, ADIH (Chamber of Industry)

2:30 p.m. -- Meeting with M. Celestin, EDH

4:30 p.m. -- Debriefing: Gerry French, USAID/PAP mission director

6:00 p.m. -- Write draft report

Thursday, 3/7/85

8:45 a.m. -- Leave PAP to DC

LIST OF DOCUMENTS REVIEWED

The Economics of Energy Use in Small-Scale Industries, Distilleries, and Sugar Mills in Haiti, prepared by Margaret Barkley for MMRE, draft report, September 1984.

Trees and Charcoal in Haitian Peasant Economy, Glenn R. Smucker, USAID/PAP, January 1981.

Peasant Tree Planting in Haiti: A Social Awareness Analysis, Gerald F. Murray, USAID/PAP, July 1981.

Prospects for Energy Conservation in a Low-Income Developing Country: The Case of Haiti, Institute for Energy Analysis, Oak Ridge Associated Universities, 1981.

Rapport du sous-secteur electricite sur l'utilisation des ressources energetiques -- periode 83-93, Electricite d'Haiti.

Recommendations de la Commission Technique sur l'Energie, January 1985.

Secteur: Resources Energetiques, MMRE, Aide Memoire, January 1985.

Energy Program for Haiti, draft report for USAID/PAP Action Plan, March 1985.

Energy Planning and Analysis in Haiti: Tasks for the Directorate of Energy Resources, G. Anandalingam, IDEA, Inc., October 1984.

Rapport sur les possibilites en geothermie, BRGM, 1984.

The Centrifugal Sugar Sector in Haiti, prepared by Leslie Delatour, consultant, for USAID/PAP, October 1983.

Haiti: Issues and Options in the Energy Sector, joint UNDP/World Bank Energy Sector Assessment Program, June 1982.

A Study of Potential Markets, Policies, and Marketing Mechanisms for the Use of Lignite Briquettes as a Fuelwood and Charcoal Substitute in Haitian Household and Small Commercial Enterprises, Terms of Reference, USAID/Washington, 1985.

Association des Industries d'Haiti (ADIH), brochure.

Etude de l'Utilisation de la Bagasse dans les Guildives a Haiti, J. Olivier, CERIS, prepared for AFME, September 1983; with two additional notes, Presse a Bagasse pour Moulin Artisanal and Distillerie de la Rue -- Etablissement Nazor, 1984.

ESMAP Activity Report on Haiti, Draft, UNDP/World Bank, October 1984.

Electricite d'Haiti: Reunion des Bailleurs de Fonds, January 1985.

APPENDIX B = EDH ELECTRICITY LOSS REDUCTION PROGRAM

3.6 L'objectif de réduction de pertes pour la présence 85-86

L'annexe I donne un résumé des réductions en fonction des interventions effectuées sur le réseau.

Les résultats déjà obtenus dans la réduction des pertes devront être améliorés, mieux que doublés.

En effet, les pertes de puissance aux heures de pointe des circuits sont réduites de 2.6 MW environ et seront diminuées de 2.4 MW additonnels. Les pertes de puissance aux heures de pointe du système sont réduites de 1.5 MW et seront diminuées de 2.3 MW.

Les économies d'énergie, dues aux réductions des pertes, voisinent 12 GWh sur une base annuelle et subiront une augmentation de 12 GWh durant la prochaine période. Le retour d'investissement annuel de 740.000 $ sera porté à 1.5 Mio $ (charge septembre 1984).

Pour éviter des confusions, il est à noter que les retours d'investissement mentionnés et obtenus ne sont pas comparables aux dépenses effectuées dans le réseau MT. On doit considérer aussi les coûts de la ligne 69 kV et des sous-stations, qui donnent leur apport dans la redistribution des circuits.

4) Etat du réseau MT en sept. 84 et du système planifié

En prenant comme point de départ la configuration du réseau en sept. 1984 (Canapé-Vert pas encore mis en service) et des mesures collectées des sous-stations, un bilan de puissance, d'énergie et de pertes a été développé et comparé à celui obtenu à partir de la nouvelle configuration du réseau. Les résultats sont portés dans les annexes 1.8.

Les commentaires suivants sont retenus :

4.1 Le bilan d'énergie et de puissance du système considéré en septembre 1984

L'annexe 2 montre le bilan des 19 circuits en 12.47 kV. Il est noter la différence entre la pointe du circuit et celle du système. Celle-ci a été produite le 13.09.84 à 11h00 et porta la valeur de 60.9 MW mesurée à partir des bornes des alternateurs. La somme des puissances aux départs MT dans les sous-stations était 58.47 MW, ce qui indique une perte de puissance de 4.12 % sur les lignes HT, incluant les auxiliaires des postes et des centrales.

Il est à remarquer que la production Joseph Janvier n'était pas en service dans les heures indiquées dans l'annexe 2. La puissance apparente de Diésel 1 et Diésel 2 ensemble représentent alors l'appel de puissance de la zone couverte par la distribution en 2.4 kV, (Joseph Janvier) qui porta la valeur de 6769 kVA avec un facteur de puissance de 0.91 et celui de la zone alimentée par Place Geffrard avec une pointe des circuits équivalente à 2180 kVA, ainsi le reste de la distribution en 12.47 kV effectuée sur le parcours de D1 et D2.

Le diagramme en annexe 3 montre la pointe des circuits et leur charge au moment de la pointe du système.
Par comparaison la charge économique maximale des circuits a été indiquée.

Il est à souligner les points négatifs suivants :

- Ancien Delmas distribue 61.3 % de la puissance totale durant la pointe du système.

- Au moins 60 MVA ou bien 80 % de la puissance distribuée sont distribués non économiquement.

Cependant, les points positifs suivants sont à remarquer :

- La distribution de la charge Cul-de-Sac, Varreux et Martissant - Carrefour.

- L'amélioration du facteur de puissance de 0.86 à 0.95, après l'installation des condensateurs.

4.2 Bilan des pertes d'énergie et de puissance

Le bilan est montré dans les annexes 4 et 5 . Il faut porter cependant la différence entre les étages MT, transfos de distribution et BT. Les pertes de puissance, au niveau MT seulement, sont estimés à 3674 kW, soit 5.12 % à partir de calculs. Aux heures de pointe du système elles sont égales à 2786 kW, soit 4.76 %. On doit y ajouter les pertes de puissance dans les transfos de distribution, soit 0.5 %, celles rencontrées au niveau BT estimées à 3 % et celles occasionnées par les auxiliaires 4.2 %. Ce qui donne un total de pertes de puissance de l'ordre de 12.5 %.

La plus grande valeur de perte à l'heure de pointe du système enregistrée sur les départs 2.4 kV des circuits de Joseph Janvier, voisine 601 kW, soit 21.5 % de toutes les pertes de puissance localisées au niveau MT du réseau, pour une puissance totale distribuée en 2.4 kV de 4754 kW, soit 8.6 % de la pointe du système.

Les pertes d'énergie ont été calculées sur le réseau MT et pour les transfos de distribution. Elles ont été cependant estimées sur le réseau BT à 3 % de l'énergie distribuée.

En septembre 1984, les valeurs suivantes ont été retenues :

Pertes d'énergie :	Moyenne tension	1302 MWh(5.15 %)
	Tranfos de distribution	582 MWh(2.3 %)
	BT (estimées)	753 MWh(3 %)

Ces valeurs ont été rapportées dans l'annexe 5, colonne "Pertes techniques d'énergie", et considérées égales à 10.5 % de l'énergie distribuée et 9.5 % de l'énergie produite (27 711 MWh).

Les pertes d'énergie sur les lignes de transmission HT (115/69 kV), incluant les auxiliaire des centrales et des sous-stations s'élèvent à 2284 MWh, soit 8.2 %.

Pour septembre 1984, le bilan d'énergie avait la configuration suivante :

A- Energie à partir bornes alternateurs	27.710.624kWh (100 %)
B- Energie distribuée à partir des s/stations	25.426.409kWh
Perte d'énergie HT et auxiliaires A - B	2.284.215kWh (8.2 %)
Perte d'énergie MT/BT	2.635.000kWh (9.5 %)
Fraude	757.875kWh (2.8 %)
C- Energie Facturée	22,710.624kWh (79.5%)

Pertes d'énergie totales avaient la valeur de 5.67 GWh, soit 20.5 %.

4.3 Système de distribution planifié

Le système de distribution MT a été calculé de nouveau, à cause des distortions dans les prévisions de charge faites par HQI dans le plan directeur, distortions dues à des considérations trop optimistes.(La différence en 1984 déjà est de 11MW, soit 4 départs MT, la différence de 1996 environ 88 MW, soit 30 départs MT) et aussi à cause du court terme des solutions proposées (d'après les documents d'appel d'offres des modifications seraient apportées déjà en 1987 au réseau).

Des interventions dans le cadre de la rénovation du réseau étaient proposées avec d'énormes acquisitions de matériel entre 1987 et 1996.

La nouvelle planification (valable jusqu'en 1995) prévoit un montant de matériel égal à la moitié de celui proposé par HQI dans les mêmes unités de temps.

Cela n'est pas valable cependant pour les coûts, qui étaient hautement sous-estimés par HQI.

Dans les annexes 6-1 et 6-2 sont résumées les caractéristiques principales du système nouvellement planifié. L'annexe 7 montre la répartition de la charge, en se référant à septembre 1984, des circuits aux heures de pointe des circuits et du système. Est représentée aussi la charge maximale économique du conducteur 477 MCM Al.

Le système planifié en comparaison de l'existant se trouve décrit dans les annexes 8 et 1.

Les améliorations sont les suivantes :

- Tous les circuits travailleront économiquement
- L'énergie économisée annuelle est de l'ordre de 20.3 GWh. Cela correspond à un retour d'investissement de 1.2 % Mio $, en se référant à la charge de sept. 84 et un coût d'énergie de 0.061 $/kWh.
- L'amélioration du facteur de puissance de 0.95 à 0.98, entraîne l'intallation supplémentaire de 9500 kVAR de condensateurs.

Le centre-ville, ù l'Entrepreneur COMEI doit intervenir pour la rénovation, a des pertes de puissance de l'ordre de 1050 kW, qui seront réduites à 71 kW après la rénovation. Cela correspond à un retour d'investissement de l'ordre de 300.000 $.

Après la rénovation du centre-ville et l'installation environ de 100 km de lignes principales, la situation sera telle que décrite dans le tableau suivant annexé.

INEXE 1

TABLEAU MONTRANT LES ECONOMIES DE PUISSANCE ET D'ENERGIE REALISEES
DURANT LA PERIODE 1983 - DEC. 1984 (BASE CHARGE SEPT. 1984)

Description	F.C.	P-Circuit économisé	P-System économisé	W Annuelle économisée	Ret. investisseme annuel
1. Redistribution du circuit CDS à Varreux	0,34	386 kW	386 kW	1,15 GWh	$ 70,129.00
2. Redistribution des circuits MAR-RIF	0,55	401 kW	122 kW	1,93 GWh	$117,853.00
3. Amélioration du facteur de puissance					
3a) Ligne de Péligre HT 0,844 à 0,95	0,59	334 kW	334 kW	1,7 GWh	$105,300.00
3b) Réseau MT-Port-au-Prince 0,856 à 0,95	0,59	734 kW	557 kW	3,8 GWh	$231,662.00
4. Report de PV2 à Canapé-Vert Octobre 1984	0,54	228 kW	52 kW	1,08 GWh	$ 65,790.00
5. Mise en service Circuit CPV-Laboule 23 - Décembre 1984	0,54	514 kW	114 kW	2,43 GWh	$148,317.00
6. Sous total 1-5		2597kW	1565 kW	12.09 GWh	$739,051.00
7. Rénovation Objectif 1985 - 1986	0,59	2435kW	2320 kW	16,79 GWh	$1,024,190.00
8. Total		5032kW	3885 kW	28,88 GWh	$1,763,241.00

4.4. [illegible] ES [illegible] ES DU SYST[illegible] E [illegible] [illegible] A [illegible] DE SEP

ANNEE	1982/83	SEPT.84	DEC.84	85/86
Pertes de puissance MT				
- max. charge système	4185 (6,9%0	2786 (4,5%)	2627 (4,5%)	300 (0,4
- max. charge circuits Kw (%)	5529	3374	2932	498
Pertes en énergie MT/BT annuelle en GWH (%)	40,2 (12,1)	31,6 (9,5)	28,1 (8,5)	0,98
- Facteur de puissance	0,85	0,95	0,95	0,98
Puissance économisée en KW par rapport à 1982/83	0	1399	1565	3885
Energie économisée par rapport à 1982/83 en GWH	0	8,6	12,1	28,9
Retour d'invetissement annuelle en $	0	524.600.-	739.051.-	1.763.241.

NOTE: - Cout d'énergie 0,061 $/KWH (1984) des pertes de transmission 115/69 KV, Auxiliaires et fra de ne sont pas inclues.

43

SUMMARY OF DATA COMPILED ON GUILDIVES
PRIMARY SOURCE: BUREAU DES CONTRIBUTIONS
Prepared by Margaret Barkley

requency Distribution of Point de Chaudiere

Range (P.C.)	Number
0,25	2
0,5	125
0,75	69
1,0	74
1,5	77
2,0	29
2,5	27
3,0	18
5,0	22
10,0	14
15,0	0
20,0	1
+20,0	3

Total No. Guildives:	461
Total Point de chaudiere:	700,29
Max. Point de chaudiere:	40,2
Minimum Point de chaudiere:	0,15
More than 2 P.C.	
Number:	85
Point de chaudiere:	400,95
Average:	4,72
Less than 2 P.C.	
Number:	376
Point de chaudiere:	299,30
Average:	0,80

Geographical Distribution of Point de Chaudiere

Location	No. of P.C.	Percent share
Port-au-Prince	108,415	15,5
Croix des Bouquets	42,151	6,0
Plaine de Leogane	119,037	17,0
Anse-a-Veau	22,57	3,2
St. Marc	59,771	8,5
Plateau Central	47,049	6,7
Plaine du Nord	76,545	10,9
Jeremie	40,28	5,6
Grand Goave	22,053	3,1
Mirebalais	12,143	1,7
Cayes	102,473	14,6

Locational Distribution of Guildives

Location	No. of Guildives	Average Size (P.C.)
Port-au-Prince	5	21,68
Croix des Bouquets	12	3,51
Plaine de Leogane	72	1,65
Anse-a-Veau	52	0,43
Dist. de St. Marc	45	1,33
Plateau Central	30	1,57
Plaine du Nord	72	1,06
Jeremie	42	0,96
Grand Goave	24	0,92
Mirebalais	28	0,43
Cayes	42	2,44

ACERIE D'HAITI is a private mill owned by Haitian investors. Located in the Port-au-Prince industrial area, Acierie d'Haiti (AH) started operations in 1974, with a total installed capacity of 40,000 tonnes of finished steel products per year, mostly used for construction. All equipment is of Spanish origin.

Initially, the mill was supposed to be fully integrated with five 5-MVA electric furnaces using scrap, but the furnaces were never installed because of unfavorable economics.

Today, the mill processes imported billets that are reheated in a furnace using No. 6 fuel oil. The mill serves the domestic market only, and is currently producing 20,000-24,000 tonnes per year with two shifts, 5 days a week. Based on the visit on March 4, 1985, the mill appeared to be in very good condition.

Electricity use. Total peak demand for the mill is about 1,000 kVA. A substation transforms 12.5 kV into 3.3 kV for large roller mill motors and 440 V for the rest of the electrical equipment. Monthly consumption runs at 200,000-220,000 kWh, or about 115 kWh per tonne of finished product, and compares well with the international standard of 100-120 kWh per tonne. The power factor, at 0.95-0.96, is also satisfactory.

Fuel use. Annual consumption of No. 6 fuel oil varies between 300,000 and 340,000 gallons or 1,100 to 1,300 toe. Fuel oil cost is $0.90 per gallon, including transport and taxes. The reheat furnace has a preheating system for primary air but not for secondary air. Specific fuel consumption is about 14 gallons per tonne, which is a good performance.

Potential for energy conservation. Two areas of potential energy cost savings have been identified: electric peak load management and secondary air preheating at the reheat furnace. The first project could probably lower the peak load of 1,000 kVA by 5 to 10 percent, and the second project could probably save 15 to 20 percent of the fuel oil currently used. Both

projects would cost about US $50,000-$75,000, including an audit and feasibility study.

BRASSERIE NATIONALE (BE) manufactures beer under license to Heineken and soft drinks under franchise. The brewery, which is entirely owned by a private Haitian group, has a capacity of 40,000 barrels per year and employs 240 people who work one or two shifts, depending on demand. It began operations in 1974. Beer production in 1984 was 250,000 cases, or 562,000 gallons, or 21,300 hl. The soft drink plant, which is older, has a capacity of 240 bottles per minute. Equipment in the brewery is of U.S., German, and Argentine make. During the visit on March 4, 1985, the brewery appeared to be in poor condition. Many leaks of water, steam, and compressed air were observed, but plant staff was well aware of these problems and working on them.

Electricity use. Peak demand is about 480 kW, and voltage is 440 V. There is a substation with a capacity of 550 kVAand an emergency Caterpillar generating set with a 328 kVA capacity. The power factor, at 0.92, is good. Average monthly electricity consumption is 150,000-180,000 kWh for the whole plant (i.e., brewery and soft drink operation). The brewery alone consumes an estimated 80-85 percent of all the electricity used, or 125,000-150,000 kWh, so specific electricity consumption is about 100 kWh per hectoliter.*

Fuel use. The brewery and soft drink plant purchases bunker fuel (No. 6) to generate steam at 125 psig using two boilers -- a Cleaver Brooks (200 hp) and a Johnston (300 hp). During the visit, it was observed that stack temperatures were much too high -- 450°C versus 150°C-200°C -- and the steam line insulation was very poor. In addition, only 50 percent of the steam condensate is returned to the boiler, the other 50 percent being discharged to sewage after use. Annual fuel consumption is about 110,000 gallons or 400 tonnes. Assuming that 87 percent (management assumption) of the steam is used in the brewery, specific fuel consumption is 19 kilograms per hectoliter of beer, to be compared with an international standard of 5-7.

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*This specific energy consumption is extremely high and probably inaccurate.

Unless the data provided during the visit are wrong, there is a great potential for energy savings at BN.

Potential for energy conservation. It is difficult to estimate the potential for energy conservation because the consumption figures do not appear to be reliable. Nonetheless, based on a visual examination of the installation, it is clear that savings of at least 20 percent can be achieved. Plant management is already interested in studying the use of water solar heaters for the washers and would welcome an energy audit at the facility.

LA MINOTERIE D'HAITI (MH), Haiti's flour mill, was visited on March 4, 1985. MH, a state-owned utility that processes about 1.5 million "quintaux" (or a hundred kilograms) of flour annually, exhibited a very simple energy use pattern.

Electricity and fuel used. Because of its location, MH is not connected to the Ed'H grid and needs to generate its own electricity. For this purpose, it operates five D399 Caterpillar generating sets of 850 kW each (of which three are running at any given time) and two 300 kW generators. All engines run at 1,200 rpm (medium-high speed), using No. 2 oil. In 1984, MH used 932,400 gallons of oil to generate 9.6 GWh, for a specific fuel consumption of 316 grams, which corresponds to an efficiency of 27 percent, average for this type of installation. The process uses only electricity and no direct heat. The power factor is low, at 0.70-0.80, which indicates room for savings at the generating station.

Potential for energy conservation. Two projects could save up to 25 percent of MH's current energy bill. The first project would entail increasing the power factor by installing capacities close to the large electric motors (grinders). The cost would be about US $60,000-$80,000 with a payback of roughly 1 year. The second project would entail the gradual replacement of the medium-high speed generator engines with medium speed (500-600 rpm) engines able to use No. 6 oil instead of No. 2 oil. In the longer term, of course, the interconnection to Ed'H should be studied. MH's management agreed with these preliminary recommendations and offered full cooperation for an energy audit program at the facility, provided the ministry agrees.

LA CIMENT D'HAITI. Once the largest industrial fuel oil user in Haiti, Le Ciment d'Haiti (CH) now uses imported coal. The plant consists of two kilns that use the wet process. The first kiln, of 200 tpd capacity, was installed in 1953 and is now rarely used. The second kiln, of 650 tpd capacity, was installed in 1974. The plant employs 550 people and produces cement for domestic consumption only. Prices are set by the government/Regie des Tabacs and sales are made from an office in Port-au-Prince. Little is known about financial data at the plant site. CH produced 228,000 tonnes of cement in 1984, which is a capacity utilization factor of almost 100 percent.

Fuel and electricity consumption. Because of its remote location from the Ed'H grid, the plant produces all its electricity. The main fuels used are coal for the kilns and bunker C for the power plant. The kiln converted to coal in 1982, and uses metallurgical fines imported mainly from the United States. The price was not known at the plant site, but is believed to be around U.S. $50/ tonne. About 50,000 tonnes are used annually, for an average thermal specific energy consumption of 1,600 kcal/kg of clinker, compared with an international standard of 1,200 kcal/kg for this type of process (the most efficient clinker kiln in Japan uses only 750 kcal/kg using the dry process). There is thus room for energy efficiency improvements.

All plant electricity is produced from 6,000 kVA of Ruston and Caterpillar diesel generators, using bunker C fuel. New, slower engines running at 420 rpm are being purchased to replace the 600 rpm current engines. Bunker C consumption and electricity produced were not available at the time of the visit. Nevertheless, the plant technical director indicated his interest in having an energy audit conducted at the facility. A major project to save energy at this plant would be the conversion of the existing kiln to the dry process, but such a costly project would be justified by increased production rather than energy savings.

JB

Category: Agro Industries

Arlequin Food Products (dairy products)
P.O. Box W52
Port-au-Prince, Haiti

Laiterie Nationale (milk and dairy products)
P.O. Box 1564
Port-au-Prince, Haiti

Societe Haitienne Agro/Industrielle (tomatoes)
(La Famosa Monterey)
P.O. Box 725
Port-au-Prince, Haiti

Society du Rhum Barbancourt (rum)
P.O. Box 33
Port-au-Prince, Haiti

Compagnie des Tabacs Comme Il Faut
P.O. Box 797
Port-au-Prince, Haiti

La Minoterie d'Haiti
P.O. Box 404
Port-au-Prince, Haiti

Category: Textiles

Societe Textile Acra S.A.
P.O. Box 2573
Port-au-Prince, Haiti

Fiticosa (Filature)

Category: Chemicals

Fabnac (soap, toothpaste, detergents, etc.)
P.O. Box 1204
Port-au-Prince, Haiti

Gaz Industriels Associes (oxygen, liquid nitrogen, acetylene, etc.)
P.O. Box 426
Port-au-Prince, Haiti

Generale Industrielle La Perle S.A. (liquid soap, detergent, etc.)
P.O. Box 415
Port-au-Prince, Haiti

Industries Groupe Nadal (paint)
P.O. Box 1311
Port-au-Prince, Haiti

Category: Construction

Acierie d'Haiti (steel wires, bars, angles, etc.)
P.O. Box 2493
Port-au-Prince, Haiti

Ciment d'Haiti (cement mill)
P.O. Box 1328
Port-au-Prince, Haiti

Category: Cosmetics

Arlequin Food Products
P.O. Box W52
Port-au-Prince, Haiti

Category: Food Processing

Huileries Haitiennes (cooking oil)
P.O. Box 2583
Port-au-Prince, Haiti

Industries Groupe Nadal (pasta)
P.O. Box 1311
Port-au-Prince, Haiti

Shabisco (bread, cookies, crackers)
P.O. Box 2529
Port-au-Prince, Haiti

Category: Packaging

Color Pack (plastic bags)
P.O. Box 2493
Port-au-Prince, Haiti

Haitian Can (cans)
P.O. Box 1327
Port-au-Prince, Haiti

National Bag and Trading Company (bags)
P.O. Box 13
Port-au-Prince, Haiti

Industries Nationales Reunies (plastics)
P.O. Box 563
Port-au-Prince, Haiti

Category: Shipping and Airlines

Industries Groupe Nadal
P.O. Box 1311
Port-au-Prince, Haiti

Category: Shoes

Fabnac
P.O. Box 1204
Port-au-Prince, Haiti

Category: Others

Duval Center (engine rebuilding, tire recapping, mattresses, etc.)
P.O. Box 203
Port-au-Prince, Haiti

Fabnac (vinyl)
P.O. Box 1204
Port-au-Prince, Haiti

Haiti Metal
P.O. Box 1327
Port-au-Prince, Haiti

Kola Borday (soft drinks)
P.O. Box 13266
Delmas, Haiti

Sada Debrosse & Cie (water purifier)
P.O. Box 2052
Port-au-Prince, Haiti

Brasserie La Couronne (cola bottler)
P.O. Box 1160
Port-au-Prince, Haiti

Brasserie Nationale d'Haiti S.A.
P.O. Box 1334
Port-au-Prince, Haiti