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COAL BRIQUETTING IN HAITI: A MARKET AND BUSINESS ASSESSMENT

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ABSTRACT

Coal briquetting can provide the impoverished land of Haiti one alternative to confront its acute deforestation problem. Extensive cutting of wood for firewood and charcoal production, as well as to clear land for agricultural purposes, has resulted in severe deforestation in the country. Using either the 6.2 million metric tons (tonnes) of proven coal reserves, other yet to be explored deposits, or imported coal, a coal briquette may provide a future way to ameliorate the problem.

The current report illuminates this possibility with an investigation into the market viability of a coal briquette. Commissioned by the U. S. Agency for International Development (USAID) and performed in cooperation with the Government of Haiti (GOH), the investigation evaluates potential market size, financial viability, consumer acceptance, and the government policy role in promoting the manufacture and sale of briquettes in Haiti.

Our results show a large and growing charcoal market in Port-au-Prince of 100,000 to 120,000 tonnes per year in 1985, much larger than previous estimates. This would support a 50,000 tonne per year coal briquetting plant. Wood users buying in lots of 100 pieces or less would provide a smaller, secondary market of about 6,000 tonnes of charcoal equivalent per year. The size and competitive nature of the current charcoal transportation, wholesale, and retail distribution chain make it easily capable of distributing the coal briquettes.

We investigated three coal briquetting options, each based on a different coal source: (1) Maissade lignite, (2) L'Azile lignite, and (3) imported coal. Financial analyses compare capital and operating costs with potential returns. Results indicate that the Maissade lignite is not economically viable in competition with charcoal at current charcoal prices. Both the L'Azile and imported coal options hold more promise. We recommend that the geology and coal quality of the L'Azile deposit be better characterized and that this option be considered further. As a second course--second only because of foreign exchange risks--we recommend the imported coal option.

The investment incentives provided by Haitian government regulations are very favorable to a coal briquetting venture, particularly the tax holidays on approved enterprises. An increased tax on charcoal, which is currently priced below its social cost due to external effects of tree cutting, could also be recommended. The social impacts of the project may involve some unemployment among charcoal producers. Overall, we recommend that USAID continue supporting the private sector as well as the GOH to conduct further geologic, technical, financial, and market test studies to implement coal briquetting in Haiti.

The Executive Summary is provided in English and French.

RÉSUMÉ

Le briquettage du charbon peut fournir au pay appauvri d'Haïti une alternative pour confronter le problème de déboisement. Bien que c'était le défrichement agriculturel qui était le grand coupable de l'acte de déboisement, la récolte des arbres pour la production du bois à brûler a contribué au problème. En vue des 6.2 millions tonnes de réserves confirmées de charbon, et des quantités supplémentaires de gîsements inexplorés de lignite à Haïti, le briquettage du charbon pourrait représenter à l'avenir un moyen pour améliorer le problème.

Le rapport sous la main éclaircit cette possibilité en présentant une revue de la viabilité des briquettes de charbon dans le marché. Sous l'égide du USAID (Agence pour le Développement International des États Unis) et exécuté avec la cooperation du Gouvernement d'Haïti, nous avons évalué au cours de ces recherches les dimensions du marché potentiel, sa viabilité financiére, son acceptation par les consommateurs, et le rôle de la politique du gouvernement pour la promotion de la fabrication et la vente des briquettes à Haïti.

Nos résultats indiquent qu'il-y-avait en 1985 à Port-au-Prince un marché annuel en pleine croissance de 100.000 a 120.000 tonnes de charbon de bois; ce marché est plus grand que ce que l'on a estimé auparavant. Il pourrait supporter une usine de briquettage de charbon avec une production annuelle de 50.000 tonnes. Les consommateurs du bois à brûler qui achètent des lots plus petits que 100 pièces, représenteraient un marché secondaire moins important, équivalent à environ 6.000 tonnes de charbon de bois par an. L'étendue et le caractère competitif de la présente chaîne de transport et de distribution en gros et en détail du charbon de bois pourrait être facilement adaptée à la distribution des briquettes de charbon.

Nous avons examiné trois options de briquettage du charbon, dont chacune est basée sur une différente source de charbon: (1) le lignite de Maissade, (2) le lignite de L'Azile, et (3) le charbon importé. Dans notre analyse financière nous avons comparé les frais d'établissement et d'exploitation avec les rendements potentiels. Les résultats ont révélé que si nous acceptons les prix actuels du charbon de bois, le lignite de Maissade ne peut pas faire la concurrence au charbon de bois. L'option du charbon de L'Azile et celle du charbon importé offrent davantage de chance de réussite. Nous recommandons que la géologie et la qualité du charbon de L'Azile soient mieux étudiées, en poursuivant davantage cette option. En second lieu nous recommandons l'option du charbon importé, que nous avons classé ainsi seulement à cause de l'incertitude liée aux devises étrangères.

Les stimulants pour l'investissement offerts par les règlements du gouvernement d'Haïti, surtout les provisions de délai de taxation, sont très favorable à l'égard des entreprises approuvées de briquettage du charbon. On pourrait aussi recommander une surtaxe sur le charbon de bois, dont le prix actuel est au-dessous de son coût social, si on

considère les effets extérieurs de la coupe des arbres. Les impacts sociaux du projet pourraient causer du chomage aux producteurs du charbon de bois. En général, nous recommandons que la USAID continue à supporter le secteur privé et que le gouvernement d'Haïti conduise des études supplémentaires géologiques, techniques, financières et de marketing pour mettre en oeuvre le briquettage du charbon de bois à Haïti.

Un sommaire pour la direction a été preparé en anglais et en français.

ACKNOWLEDGEMENTS

Credit for this report is difficult to assign because so many people have contributed to its completion. The authors would especially like to thank Claude Jean-Poix and Naquin Medina of the Haitian Ministry of Mines and Energy Resources (MMRE), whose help was so great that we have listed them as authors under the "assisted by" category. Claude Jean-Poix headed the Institutional and Government Policy Assessment for MMRE. Much of Chapter 4 of this report is a result of his research and writing. Naquin Medina headed MMRE's efforts on the market assessment, and worked hard to make that endeavor a success.

Mr. Betonus Pierre, as head of MMRE's Lignite Development Project, provided invaluable assistance all through our work. His supervision of both of MMRE's tasks just mentioned was augmented by a helping hand whenever some assistance in "hands on" work was needed. Mr. Wilfred St. Jean, Director of the Directorate of Energy Resources in MMRE, should be thanked for always being prepared to assign people and priority to the needs of this project.

For supervision of the survey work we would like to thank Loctamard Antilus. We could not have completed the study without his assistance and the work of his survey team. The survey team, whom we would like to thank for performing the wearisome task of talking to hundreds of people, consisted of Nicole Dieudonne, Alix Malique, Venort Ancelot, and Guilene Rene.

Yvon Beauboeuf should also be thanked for his assistance to Claude Jean-Poix in the Institutional and Government Policy Assessment.

We would also like to thank Mr. Clarence Kooi. In his capacity as the U.S. Agency for International Development (USAID) Resident Energy Advisor to MMRE, Clarence provided information and assistance that proved very valuable for the work. Some of the information from prior survey work, especially in the essential oils industry and the school canteens, was available to us only because Clarence had supervised its collection and analysis.

We are also indebted to Lisa McGowan and Gerry Grosnick of the University of Maine, who were involved in the USAID-funded Agroforestry Outreach Project in Haiti. They provided raw data on charcoal imports to Port-au-Prince that significantly influenced our thoughts on market size. They did so months before their report was due, and we did not wish to preempt their work, but rather thank them for it.

Mr. Carl Braun and Nancy Allen of Capital Consult and Criss Juliard of USAID/Haiti deserve our thanks for assisting us in understanding the attitudes and requirements of the Haitian private sector, as well as for directing us to entrepreneurs and bankers to whom we could talk.

Finally, we wish to thank Muriel Jolivert, John Airhart, Richard Byess, Wendy King and others at the AID/Haiti Mission who stood ready with assistance and feedback as our project progressed.

EXECUTIVE SUMMARY

OBJECTIVES

Extensive cutting of wood for firewood and charcoal production, as well as to clear land for agricultural purposes to keep up with rapid population growth, has resulted in severe problems of soil erosion, reduced agricultural productivity, and desertification in Haiti. Firewood and charcoal account for approximately 75% of Haiti's energy use, and the growing urban population, which uses primarily charcoal for cooking, contributes to a fuelwood consumption rate about twice the natural wood replacement rate. Consequently, real delivered prices of wood and charcoal have increased by 30% over the last ten years, and firewood and charcoal supplies are increasingly being drawn from more distant and remote locations within Haiti.

Without a change in these trends, economically available supplies of fuelwood will be exhausted, much of the land will have been rendered significantly poorer in terms of agricultural productivity, and the likelihood of the urban centers switching to expensive imported petroleum-based fuel such as kerosene and bottled gas will increase.

Because Haiti possesses some known, though only minimally evaluated, deposits of lignite coal, the U.S. Agency for International Development (USAID) and the Government of Haiti believe that the possibility of introducing a coal-based solid fuel as an alternative to wood and charcoal in Haiti should be examined. Consequently, USAID requested that the Oak Ridge National Laboratory (ORNL) assess the market and business aspects of such an option. Specifically, ORNL was asked to undertake a study with the following objectives:

- To evaluate the market for a coal-based alternative fuel, including market size, prices, and consumer behavior issues;
- To assess the business and commercial aspects, including the financial viability and business arrangements appropriate for such a venture;
- To investigate how the Haitian institutional and government policy setting would affect a coal briquetting operation.

In parallel with these market and institutional assessments, USAID commissioned the University of North Dakota Energy Research Center to do technical examinations of the Haitian lignite deposit at Maissade in the Central Plateau. The purposes of that study included characterization of the coal quality, experimentation to produce a prototype coal briquette using the lignite, and formulation of a plant design for production of the briquettes, including capital and operating costs. The preliminary findings of their study have been utilized in performing the economic assessments in this report.

This report summarizes the results, conclusions, and recommendations from the market assessment, the business assessment, and the institutional and policy assessment.

MARKET STUDY RESULTS

A large and growing demand for charcoal exists in Port-au-Prince, with annual charcoal consumption estimated at 100,000 to 120,000 tonnes per year. This charcoal is used primarily for residential cooking, with smaller additional amounts used by restaurants and street food vendors. Retail prices have risen in recent years to approximately 20-30 gourdes per gros sac ("large sack"), or about $105-$155 per metric ton.

Charcoal is also used in the countryside and in other urban centers, but the prices tend to be lower than in Port-au-Prince, making those markets less viable targets for fuel substitution.

Wood users in the Port-au-Prince commercial sector (e.g., bakeries and dry cleaners) are a second potential market, but of much smaller proportions. Much wood is sold by the truck load at prices about one-half the price of charcoal on a heat equivalency basis. This part of the market, whose size is estimated in Chapter 2, probably cannot be penetrated. The remaining wood, about 12,000 tonnes per year (or about 6,000 tonnes per year of charcoal equivalent) in Port-au-Prince, is sold in small units, such as lots of 100 pieces. This part of the wood market commands prices high enough to be penetrable by a coal briquette, assuming that the briquette is technologically substitutable for firewood.

The existing charcoal transportation and distribution infrastructure could be adapted easily to deliver a coal-based fuel, and consumers expressed willingness to try a new fuel as long as the price and quality were comparable to or better than charcoal.

FINANCIAL ASSESSMENT RESULTS

A preliminary assessment of the financial viability of the coal briquetting venture in Haiti was made on the basis of market data for charcoal selling prices and for transportation and distribution costs, briquetting costs derived from the process and capital costs developed by the University of North Dakota, and assumed coal costs based on experts' judgement for mining Haitian coal and/or importing coal.

Three options were evaluated:

1. Manufacture of briquettes from the Maissade lignite deposit.

2. Manufacture of briquettes from the L'Azile coal deposit in the Southwestern peninsula of Haiti.

3. Manufacture of coal briquettes from imported coal.

The technical investigations at the University of North Dakota indicated that briquettes could be produced that were considered

satisfactory with regard to ease of ignition, odor, and handling strength. However, the briquettes had a high ash content (approximately 40%), which could result in consumer resistance. A thorough investigation of the feasibility of washing the coal to reduce this ash was not undertaken. Technical investigations at the East-West Center in Hawaii indicated that carbon monoxide and particulate matter emissions from the briquette would be acceptable. Sulfur emissions, however, would be high enough to warrant extreme caution that sufficient ventilation be provided when the briquettes are burned.

The conclusions from our economic evaluation for the three options are:

- o Maissade coal briquettes - Briquettes manufactured using the University of North Dakota process would not be financially viable at current charcoal prices. If an economic coal washing step can be identified, reevaluation of the Maissade lignite option may be warranted. As it stands, only a significant rise in real charcoal prices would make a Maissade lignite briquette economic.

- o L'Azile coal briquettes - Briquettes manufactured from the most promising samples indicate that briquetting would be financially attractive according to the investment criteria required by the Haitian private sector. However, deposits similar to the poorer L'Azile samples would give results comparable to the Maissade lignite.

- o Briquettes manufactured from imported coal - A financial return comparable to that from the better L'Azile lignite samples appears possible, but considerable foreign exchange would be needed.

- o Private sector interest - There is strong interest in the private sector in undertaking a business venture to manufacture coal briquettes if the financial return can be demonstrated. Considerably stronger interest exists for the use of Haitian coal because of the reduced foreign exchange requirements, but processes based on imported coal would also be considered if the return is commensurate with the greater risks.

- o Competition with kerosene - Real charcoal prices would have to increase from present levels for kerosene to be competitive. Since certain coal briquetting options are probably already competitive with charcoal, coal briquetting would probably prove advantageous over importing kerosene for domestic use. The increase in real charcoal price necessary to make Maissade lignite economically viable, however, would also bring kerosene near viability. This does not account for new equipment needed to burn kerosene or the larger in-country value-added offered by coal briquetting.

INSTITUTIONAL AND GOVERNMENT POLICY ASSESSMENT RESULTS

Haitian government regulations and institutions are conducive to private sector development of coal briquetting, from mining through manufacturing, distribution, and sales. In mining and minerals-based industries, the Government of Haiti (GOH) has tended toward concessionary agreements leaving complete control to private interests with potential stipulations only on employment of local labor, environmental, health and safety restrictions, etc. The GOH does not tend to engage in joint ventures. This is a positive circumstance for coal briquetting, because involvement of the Government of Haiti is not viewed positively by the private sector and most businessmen would not be interested in participating if the government were involved in the venture.

In addition, the GOH as a rule does not engage in subsidization of commercial ventures. However, an increased tax on charcoal may be one method to encourage the use of a coal briquette. Such a tax could be justified, since the price of charcoal does not currently include the scarcity value of the trees from which charcoal is made. Property rights for trees are poorly defined in Haiti and cutters often pay nothing for harvesting the trees. In addition, many trees are cleared mainly to open the land for agricultural cultivation. In either case, the value of the trees for soil conservation and hindering further desertification is not considered, nor is it contained in the price of charcoal. A tax on charcoal reflecting the social value of the trees could be justified, although the equitable enforcement of such a tax would be a major problem.

The government's approval for profits tax holidays and other commercial incentives will be beneficial to gain private support. Fortunately, Haiti provides liberal incentives in this direction, with full and partial tax holidays extending 10 years in the Port-au-Prince area and up to 20 years for ventures outside of Port-au-Prince. Probably customs exemptions would be available also, which would be important for the capital equipment and some variable inputs necessary for coal briquetting.

The social impacts of the project must be approached with caution, with possible ameliorative actions taken. Mainly, current charcoal producers may be displaced by a coal briquetting venture, and these people can be among the poorest in Haiti. Some job creation in mining and/or at the plant may help to offset this, and the fact that charcoal producers may lose their jobs anyway as trees disappear also discounts this effect.

The involvement of USAID in some form, such as in the preparation of the feasibility study, is viewed positively by private entrepreneurs, providing greater credibility to the venture and improving the basis for seeking attractive development bank financing.

RECOMMENDED ACTIONS

Because of the promising results from the L'Azile samples and the imported coal option, it is recommended that USAID continue to sponsor the preliminary feasibility assessment work regarding a coal-based alternative fuel to charcoal. Specifically, the following actions are recommended.

- o L'Azile geological testing - The Haitian Ministry of Mines and Energy Resources is preparing to undertake a geological assessment of the L'Azile coal deposit. USAID should consider assisting in the financing of this geological work, and sponsoring preliminary washing and coal briquetting tests with this lignite.

- o Evaluation of imported coal alternatives - A wide range of imported coals could be delivered to Haiti, each requiring a different coal briquetting process for optimum results. USAID should sponsor a study to determine the most attractive combinations of coal type and briquetting processes and to confirm financial viability. At the same time, an evaluation of the price competitiveness of such briquettes if exported to other Caribbean countries should be evaluated, in an effort to balance the hard currency requirements.

If the above steps confirm the potential viability of coal briquettes, the following steps to implement the business plan should be undertaken to provide the basis for raising equity and debt financing:

- o Form a private sector working group to assist and guide subsequent efforts.

- o Conduct a detailed market test of coal briquettes in Haiti. This would involve manufacturing sufficient quantities of briquettes from Haitian coal (or equivalent) and testing those in the marketplace to insure that they perform satisfactorily under actual residential cooking conditions. This will confirm technical acceptability, consumer acceptance, and pricing assumptions.

- o Conduct detailed technical assessment to confirm the most economic coal briquette process, to design a plant, and to determine the resulting capital and operating costs.

- Complete a "bankable" feasibility document in conjunction with the private sector.1/

If a private sector venture is likely to proceed, USAID may consider playing a role in the initial stages of the business plan, including the following possibilities:

- Funding technical assistance in plant construction and commissioning.

- Financial assistance for a small scale plant near Port-au-Prince, which can be used to develop the in-country briquetting expertise, and to produce initial quantities of briquettes for the marketplace.

- Assistance in achieving initial market penetration through purchases of briquettes for captive customers such as school canteens.

It is likely that considerable interest from Haitian private businessmen will be available to support USAID initiatives. In particular, help and participation in the conduct of a market test could be obtained easily. Their participation in the operation of an initial small scale plant is also likely, if foreign donor assistance is provided.

There is a very strong belief among the Haitian business community that the market for an alternative fuel is very attractive, and if a viable business plan can be developed, a purely private sector venture is likely to evolve. However, continued participation by international donors in the early feasibility stage is necessary because of the considerable technical and financial requirements. These exceed the willingness of most potential investors to take the risk without USAID or other international donor agency participation.

1/ By a "bankable" feasibility document, we mean a description of the financial, marketing, and engineering details of a project. Such a document lays out capital and construction plans, personnel and other operating needs, estimates the costs of these requirements, reviews the expected market and associated returns, and calculates expected profits and internal rate of return. Also included are proposed equity and debt financing arrangements. It is a "bankable" document because it shows the financial feasibility of the project and can be taken to banks to solicit loans for the project.

SOMMAIRE POUR LA DIRECTION

BUTS

La coupe des arbres à grande échelle pour produire du bois à brûler et du charbon de bois, ainsi que pour défricher le terrain dans des buts agricoles, du à l'augmentation rapide de la population, à causé l'érosion sévère du sol, réduisant sa capacité de production et a contribué à la désertification d'Haïti. Le bois à brûler et le charbon de bois representent environ 75% de la consommation d'énergie d'Haïti, et la population urbaine en pleine croissance, qui préfère le charbon de bois pour faire la cuisine, contribue à la consommation du bois à un taux environ deux fois plus élevé que celui du remplacement naturel des arbres. Par consequant, les prix réels de livraison du bois et du charbon de bois sont augmenté de 30% pendant les derniers dix ans et les stocks de charbon de bois sont obtenus de plus en plus de points très eloignés et peu accessibles du pays.

Si ces tendances ne changeront pas dans l'avenir, les fournitures du bois à brûler disponibles dans le commerce seront épuisées, réduisant considerablement la productivité agricole d'une grande partie du pays et augmentant la probabilité que les centres urbains seront forcés d'utiliser de combustibles importés et plus chers à base de pétrole, tels que kerosène et gas comprimé.

Comme il est connu qu'Haïti possède de gîsements de charbon, bien que peu evalués, sous forme de lignite, la USAID et le gouvernement d'Haïti considèrent qu'un combustible solide à base de charbon devrait être étudié pour l'introduire au pays comme remplaçant du bois et du charbon de bois. Par conséquant, la USAID à demandé que le Laboratoire National d'Oak Ridge évalue les problèmes de marketing et d'affaires de cette option. Plus exactement, on a proposé les buts suivants pour l'etude entreprise par le Laboratoire National:

- o Évaluation du marché pour un combustible alternatif à base de charbon, y compris l'étendue du marché, les prix et les questions concernant le comportement des consommateurs;

- o l'étude des problèmes d'affaires et commerciaux, y compris la viabilité financière et les conditions d'affaires requises par une telle action;

- o l'étude de la question comment la politique institutionnelle et gouvernementale haïtienne pourrait influencer les operations de briquettage du charbon.

En parallèle avec ces études du marché et des institutions, la USAID a chargé le Centre d'Études Énergetiques de l'Université de Dakota du Nord d'examiner les aspects techniques des gîsements de lignite d'Haïti à Maissade dans le Plateau Central. Les buts de cette étude ont compris l'évaluation de la qualité du charbon, l'exécution des experiences concernant la production de briquettes prototypes de charbon à base de

lignite et le développement des plans d'une usine de production de briquettes, y compris les dépenses de capital et les frais d'exploitation. Les résultats préliminaries de cette étude ont été utilisés pour l'évaluation économique présentée dans ce rapport.

Le rapport présente un sommaire des résultats, conclusions et recommandations basés sur l'évaluation du marché, des affaires et de l'étude institutionnelle et politique.

LES RÉSULTATS DE L'ÉTUDE DU MARCHÉ

À Port-au-Prince il-y-existe une demande croissante pour le charbon de bois; la consommation annuelle de cette matière est estimée à 100.000-120.000 tonnes par an. Cette quantité de charbon de bois est utilisée surtout pour le cuisinage résidentiel; des quantités supplémentaires moins importantes sont consommées par les restaurants et les vendeurs ambulants d'alimentation. Pendant ces dernières années les prix de détail ont augmenté à environ 20 à 30 gourdes par "gros sac", c'est-à-dire, à $105-155 par tonne.

Le charbon de bois est aussi utilisé en province et dans les autres centres urbains mais les prix de vente sont en général plus bas qu'à Port-au-Prince; ainsi ces marchés représentent des buts moins susceptibles pour le remplacement du combustible.

Les utilisateurs du bois dans le secteur commercial de Port-au-Prince (par exemple, les boulangeries et les boutiques de nettoyage-à-sec) représentent un deuxième marché, qui est cependant mois important. Beaucoup de bois est vendu aux prix d'environ la moitié du celui du charbon de bois par rapport à équivalence de capacité de chauffage. Cette portion du marché, dont l'étendue est estimée dans Chapitre 2, probablement ne peut pas être pénetrée. Le restant du bois, environ 12.000 tonnes par an (ou environ 6.000 tonnes par an d'équivalent du charbon de bois) à Port-au-Prince, est vendu en petites unités, par exemple, par lots de 100 pièces. Les prix de vente dans cette partie du marché sont suffisament élevés pour permettre le remplacement par une briquette de charbon, sous la condition que les briquettes peuvent être substituées du point de vue technique au bois à brûler.

L'infrastructure présente de la transportation et la distribution du charbon de bois pourrait être convenablement adaptée à la livraison d'un combustible à base de charbon; les consommateurs ont indiqué qu'ils sont disposés à essayer un combustible nouveau tant que le prix et la qualité sont les mêmes ou superieurs à ceux du charbon de bois.

LES RÉSULTATS DE L'ÉTUDE FINANCIÉRE

Nous avons evalué la viabilité financière d'une entreprise de briquettage à Haïti à la base des données de marché concernant le prix de vente, le coût de transportation et de distribution du charbon de bois, les frais de briquettage et les frais d'établissement calculés par l'Université de Dakota du Nord, et les coûts présumés du charbon tirés de l'opinion des experts de l'exploitation des mines de charbon d'Haïti et/ou l'importation du charbon.

On a évalué trois options:

- o la manufacture des briquettes à partir des gîsements de lignite de Maissade;
- o la manufacture des briquettes à partir des gîsements de charbon de L'Azile, situés dans la presqu'ile sud-ouest d'Haïti;
- o la manufacture des briquettes de charbon à partir du charbon importé.

Les recherches techniques exécutées à l'Universite de Dakota du Nord ont révelé qu'il est possible de produire des briquettes considerées acceptables de points de vue de l'allumage, l'odeur et la résistance à la manipulation. Pourtant, ces briquettes ont contenu trop de cendres (environ 40%), ce qui pourrait décourager les consommateurs. On n'a pas fait une recherche détaillée de la praticabilité de laver le charbon pour réduire ce contenu en cendres. Des études techniques entreprises au Centre Est-Ouest d'Hawaii ont indiqué que les émissions de monoxide de carbone et de particules provenant des briquettes seraient acceptables. Pourtant les émissions de souffre seraient assez élevées pour exiger une ventilation suffisante quand on brûle les briquettes.

Nous présentons plus bas les conclusions de notre évaluation économique des trois options:

- o Les briquettes de charbon de Maissade. Les briquettes fabriquées selon la méthode élaboree par l'Université de Dakota du Nord ne sont pas considerées d'être viable aux prix courants du charbon. Si on pouvait exécuter le lavage du charbon d'une manière plus économique, on devrait reévaluer l'option basée sur le lignite de Maissade. Pour le présent, seulement une hausse importante du prix réel du charbon de bois pourrait rendre économique le lignite de Maissade.

- o Les briquettes de charbon de L'Azile. Les briquettes fabriquées avec les échantillons les plus promettants présentent des avantages pour attirer du capital selon les critères d'investissement du secteur privé haïtien. Cependant, les échantillons moins favorables de L'Azile donnent des résultats similaires à ceux obtenus avec le lignite de Maissade.

- o Les briquettes fabriquées à partir du charbon importé. Il parait possible d'obtenir des bénéfices financiers comparable à ceux réalisés avec les échantillons de lignite de l'Azile mais une telle entreprise nécessiterait une somme importante en devises étrangères.

- o L'interêt du secteur privé. Le secteur privé a exprimé un grand interêt dans des investissements pour la manufacture des briquettes de charbon, si on y pouvait démonter la probabilité d'un bon rendement financier. Il-y-a plus d'interêt pour l'utilisation des charbons d'Haïti parce qu'ils éxigent moins de devises étrangères, mais on est preparé de considérer aussi les

méthodes basées sur les charbons importés si les bénéfices étaient commensurables avec les risques plus élevées.

- o La concurrence avec le kerosène. Les prix réels du charbon de bois devraient monter par rapport aux niveaux présents pour rendre le kerosène compétitif. Puisque certaines options de briquettage du charbon sont déjà compétitifs avec le charbon de bois, le briquettage du charbon devrait présenter des avantages en comparaison avec l'importation du kerosène pour l'usage domestique. Cependant, la hausse du prix réel du charbon de bois qui est nécessaire pour rendre le lignite de Maissade économiquement viable, aumenterait aussi les chances du kerosène, en le rendant presque competitif. Ceci ne prend pas en considération l'équipement nouveau nécessaire pour brûler le kerosène, ou la valeur accrue dans le pays due au briquettage du charbon.

RÉSULTATS DE L'ÉVALUATION DE LA POLITIQUE INSTITUTIONNELLE ET GOUVERNEMENTALE

Les règlements et les institutions du gouvernement haïtien supportent le développement par le secteur privé de toutes les phases du briquettage du charbon, y compris les travaux miniers, la manufacture, la distribution et la vente. En ce qui concerne l'exploitation des mines et les industries basées sur les minéraux, le gouvernement d'Haïti présente une tendance de conclure des contrats de concession, en laissant la gérance des affaires aux interêts privés, peut-être avec des réservations que la main d'oeuvre locale soit employée et que les considérations de santé publique, de souci pour l'environnement et la sûreté publique soient respectées. Le gouvernement n'a pas exprimé un interêt de participation dans les entreprises. C'est une condition positive pour le briquettage du charbon parce que le secteur privé ne considère pas la participation du gouvernement comme un facteur positif et la plupart des hommes d'affaires ne seraient pas intressée à participer dans l'entreprise si le gouvernement y était un partenaire.

En plus, en général le gouvernement d'Haïti ne subventionne pas les affaires commerciales. Pourtant, une taxe accrue sur le charbon de bois pourrait encourager l'utilisation des briquettes de charbon. On peut bien justifier une telle taxe parce que le prix du charbon de bois ne réflechit pas la valeur de rareté des arbres, la source de la matière première pour la fabrication du charbon de bois. Le droit de propriété concernant les arbres est mal definie dans le pays et les coupeurs souvent ne payent rien pour couper les arbres. En plus, bien souvent les arbres sont coupés simplement dans le but de défricher le terrain pour la cultivation agricole. Dans ces cas on ne prend pas en considération la valeur des arbres pour conserver le sol et pour empêcher la désertification et cette valeur n'est pas réflechie dans le prix du charbon de bois. On pourrait justifier une taxe sur le charbon de bois qui représenterait la valeur des arbres pour la société, bien qu'il faut admettre que la mise en vigueur d'une telle taxe présenterait des problèmes sérieux.

L'approbation du gouvernement pour la suspension des taxes sur les profits et autres encouragements commerciaux représentent des actes qui aideraient à gagner le support des interêts privés. Heureusement, l'Haïti pourvoit des encouragements généreux dans ce domaine, y compris la suspension totale et partielle des impôts pour des périodes jusqu'à dix ans à Port-au-Prince et jusqu'à vingt ans pour les entreprises situées en dehors de la capitale. C'est bien probable qu'il-y-auraient aussi des éxemptions douanières qui pourraient être trés importantes pour les biens réels et pour certains facteurs variables qui sont nécessaires pour le briquettage du charbon.

On doit prendre garde des impacts sociaux du projet en appliquant des mesures amélioratives. Principalement, les producteurs actuels de charbon de bois pourraient être destitués par l'établissement des entreprises de briquettage de charbon; ces gens sont souvent parmi les habitants les plus pauvres du pays. On pourrait compenser pour cet état d'affaires par la création de postes d'emploi dans les mines et/ou les usines; de toute façon, il faut aussi prendre en considération le fait que tôt ou tard les producteurs du charbon de bois vont perdre leur emploi quand les arbres disparaissent.

Les entrepreneurs privés considèrent la participation éventuelle de la USAID d'une manière quelconque, par exemple, dans la preparation d'une étude de praticabilité, comme un facteur positif; une telle participation augmenterait la crédibilité du projet, en facilitant l'obtention des crédits bancaires.

ACTIONS RECOMMANDÉES

En vue des résultats prometteurs obtenus avec les échantillons de L'Azile et l'option du charbon importé, on recommande que la USAID continue de supporter l'étude préliminaire de praticabilité concernant l'utilisation d'un combustible alternatif à base de charbon pour remplacer le charbon de bois. Plus spécifiquement, on recommande d'entreprendre les actions suivantes:

- o Les essais géologiques de L'Azile. Le Ministère des Mines et des Ressources Énergetiques d'Haïti prépare l'évaluation des gîsements de charbon de L'Azile. La USAID devrait considérer de pourvoir le support financier aux travaux géologiques et aux essais préliminaries de lavage et de briquettage du charbon à partir de ce lignite.

- o L'évaluation des alternatives basées sur le charbon importé. Un grand assortement de charbons peut être importé àu Haïti; chacune de variétés éxige une méthode différente de briquettage pour obtenir le meilleur resultat. La USAID devrait supporter une étude pour déterminer les meilleures combinaisons de l'èspece de charbon et de la methode de briquettage et pour confirmer la viabilité financière du projet. En même temps, on pourrait déterminer si le prix de vente des briquettes exportées aux autres pays des Antilles étaient compétitif dans le but de balancer les demandes de devises.

Si ces mesures confirment la viabilite potentielle des briquettes de charbon, on recommande d'entreprendre les démarches suivantes pour réaliser le plan d'affaires dans le but de fournir une base d'équité et de financement des créances.

- o La création d'un groupe de travail dans le secteur privé pour aider et guider les efforts dans l'avenir.

- o L'exécution d'un examen détaillé du marché des briquettes de charbon au Haïti. Ceci demande la manufacture des quantités de briquettes à partir du charbon d'Haïti (ou son équivalent), en les essayant dans le marché pour assurer qu'elles fonctionnenet d'une manière satisfaisante dans des conditions réelles de cuisinage résidentiel. Cette étude confirmera l'acceptation technique, l'accueil favorable par les consommateurs et la justesse des suppositions de prix.

- o L'exécution d'une étude technique détaillée pour déterminer la méthode la plus économique de briquettage du charbon, préparer les plans d'une usine et déterminer les frais d'établissement et de fonctionnement.

- o La préparation d'un "document de praticabilité d'emprunt bancaire" en cooperation avec le secteur privé.1/

S'il devient probable qu'une entreprise en participation se réalisera, la USAID pourrait considérer de jouer un rôle pendant les premiers stages du plan, y comprise les choix suivants:

- o Fourniture de fonds pour l'assistance technique concernant la construction et la mise-en-service de l'usine.

- o Assistance financière à une petite usine près de Port-au-Prince qui peut servir pour le développement de l'expertise de briquettage dans le pays et pour la production des quantités initiales de briquettes pour le marché.

- o Assistance dans la pénétration initiale du marché à l'aide des achats de briquettes pour des clients captifs, tels que les cantines scolaires.

1/L'expression "document de praticabilité d'emprunt bancaire (ou 'banquable')" signifie la description detaillée des aspects financiers, de marché et techniques d'un project. Un tel document décrit les éxigeances de capitaux, de personnel et d'autres moyens de fonctionnement; il contient l'estimation des coûts de ces éxigeances; on y examine le marché anticipé et les remboursements associés, et on calcule les profits anticipés et le retour sur investissement. En plus, le document contient l'équité proposée et les dispositions pour financer la dette. C'est un document "banquable" parce qu'il présente la praticabilité financière du project et on peut le présenter à une banque pour demander des emprunts pour le projet.

Il est probable que les initiatives du USAID évoqueront un grand interêt dans la communauté privée des hommes d'affaires haïtiens. En particulier, il sera facile d'obtenir assistance et participation dans l'exécution des tests du marché. Il est aussi très probable que les hommes d'affaires privés d'Haïti vont coopérer dans l'exploitation d'une petite usine si la participation de donateurs étrangers est assurée.

La communauté d'affaires haïtienne parait être fortement convaincue que le marché d'un combustible alternatif est très attrayant, et si on réussit de développer un plan d'affaires viable, il est très probable que le secteur privé y participera tout seul. Cependant, en vue des éxigeances techniques et financières très importantes, il est nécessaire de maintenir la participation suivie des donateurs internationaux pendant le premier stage de praticabilité. Ces éxigeances dépassent la disposition de la plupart des investisseurs potentiels d'accepter des risques sans la participation de la USAID ou d'autres agences donatrices internationales.

1. INTRODUCTION

1.1 PURPOSES AND OBJECTIVES

This report examines the feasibility of introducing coal briquettes into the Haitian fuel economy. Such a fuel is intended to be a replacement for the currently used, wood-based fuels of firewood and charcoal. While others have examined the technical aspects of producing a coal briquette for Haiti (see Hauserman and Johnson), this report's primary focus is on the market and business aspects of such an undertaking. In addition, this report reviews certain social and institutional aspects of introducing a coal briquette in Haiti.

The investigation was commissioned by the United States Agency for International Development (USAID) and has four specific goals:

1. Assess the potential market for coal briquettes in Haiti, including:

   - Determine the market size for a coal briquette in Haiti

   - Determine the relevant prices of competing fuels, particularly wood and charcoal, and deduce the price at which a coal briquette would have to enter the market to compete

   - Describe the distribution system for the current fuels; assess the degree of resistance to the introduction of a new product that the current system would present; examine the possibility of using the current distribution system to deliver the new product to market

2. Assess the viability of a private sector venture, including:

   - Determine how a private sector coal briquetting venture would most effectively be established

   - Analyze the likely financial viability of such a venture in light of Haitian private sector investment criteria and the prices of current fuels

   - Assess the extent of private sector interest in initiating a coal briquetting venture in Haiti

3. Describe nonprice factors relevant to the decision of introducing a coal briquette to Haiti, including:

   - Land and mineral rights issues

   - Government regulations, tax and subsidy issues

   - Real capital and technical talent availability

- Infrastructure
- Social, environmental, and public health impacts
- Other institutional and policy issues

4. Identify and recommend appropriate actions for USAID to help stimulate private sector initiatives in coal briquetting

1.2 BACKGROUND ON HAITI AND ITS COAL BRIQUETTING POTENTIAL

Haiti occupies the western third of the island of Hispaniola in the Caribbean Sea, sharing the island with the Dominican Republic. It is a country of about six million people with a high population density at 211 people per square kilometer. Haiti is the poorest country in the Western Hemisphere, with per capita income of approximately US$ 300 per year. Great pressure has been put on the land for food production, because agriculture--much of it subsistence agriculture--supports approximately 80% of the population.

Land clearing for agriculture, along with the demand for wood and charcoal for fuels, has contributed to widespread deforestation in the country. Wood and charcoal dominate Haiti's energy economy, supplying fully 75% of the country's energy supply. Forty years ago wood was gathered and charcoal produced for Port-au-Prince, the capital and largest city, only a few kilometers beyond the city limits. To supply the capital city today, trees are felled and wood gathered at the extremities of the country, ranging from 100 to 300 kilometers away.

As a result of the increasing scarcity of wood, the real price of charcoal in Port-au-Prince has increased 30% in the last ten years (see Exhibit 1-1). Yet even with the increasing real price of fuelwood, it is still extremely cheap. The retail price of charcoal in Port-au-Prince, for instance, ranges between US$ 105 and US$ 155 per metric ton (tonne)--and in the countryside comparable prices are typically one-third to one-half of these figures. These low prices arise because property rights to land and trees are very poorly defined in Haiti, and stumpage fees are rarely collected. Thus, the original wood resource is imputed a zero or near zero cost, with only the harvester's time adding to the cost of charcoal.

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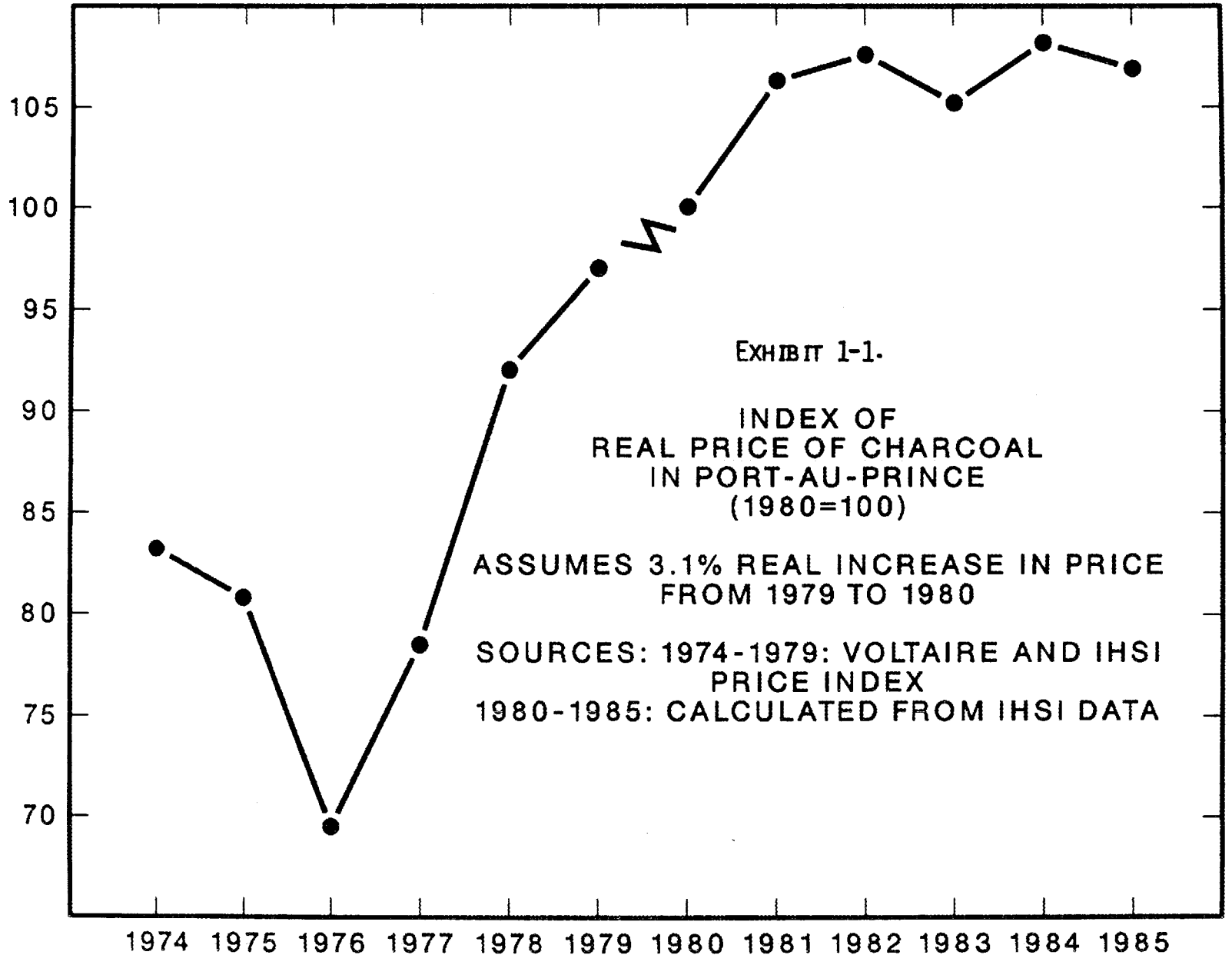

EXHIBIT 1-1.

INDEX OF
REAL PRICE OF CHARCOAL
IN PORT-AU-PRINCE
(1980=100)

ASSUMES 3.1% REAL INCREASE IN PRICE
FROM 1979 TO 1980

SOURCES: 1974-1979: VOLTAIRE AND IHSI
PRICE INDEX
1980-1985: CALCULATED FROM IHSI DATA

Haiti has several deposits of lignite coal, none of which has been fully characterized geologically. The deposit about which most is known lies near Maissade in the country's Central Plateau region. An assessment of this deposit for coal to supply a thermal power plant was conducted by the German Federal Institute for Geologic and Material Sciences in 1982 (Hugel). The study estimated proven, recoverable reserves of lignite at 6.2 million tonnes. These reserve estimates are considered low, since the survey covered only 2% of the total area in the Maissade with potential reserves. Still, proven reserves would last 30 to 40 years for a briquetting operation, and actual reserves could last much longer. The coal is relatively low grade, being high in moisture, ash, and sulfur contents. Due to the high ash and moisture contents, the caloric content is low, generally in the range of 2500 to 3000 kilocalories per kilogram (kcal/kg) (Hauserman and Johnson).

A second lignite deposit exists at L'Azile in the mountains of Haiti's southwestern peninsula. This deposit remains geologically unmapped, and no core borings have been made. Several samples have been taken from two different outcrops, and based upon these samples, the L'Azile lignite appears to be of higher quality than the Maissade lignite. Some samples indicate a higher calorific value and lower ash and sulfur contents. The size of reserves, however, is unknown.

Other lignite deposits exist, such as at Camp Perrin. However, none of them was considered in the current analysis.

With wood resources rapidly dissipating in Haiti, the price of wood fuels rising, and the existence of lignite deposits in the country, examination of coal briquetting in Haiti is a logical choice. It is not anticipated that a coal briquette could completely replace existing wood fuels at the present time, but its partial substitution could ease problems of deforestation and soil erosion. Also, the experience of other countries indicates that kerosene and natural gas otherwise are the likely substitutes as fuelwood supplies disappear and prices rise. Coal briquettes may provide a cheaper option than these petroleum-based fuels, either by drawing on the indigenous lignite reserves or by providing more in-country value added if imported coal is used.

Haiti also has a very active private sector, ranging from the small, street-level vendors and entrepreneurs to wealthy investors and managers with an interest in attractive new opportunities. The approach for this report has been to build a coal briquetting venture on this foundation by using solely private management. The venture has been evaluated rigorously, by gathering the reactions of individuals in the private sector and using their evaluation criteria. While donor organizations like USAID can be helpful in providing technical assistance prior to operation, the venture is most likely to succeed in Haiti if it is operated by the private sector without government involvement.

1.3 OVERVIEW OF RESEARCH GROUPS IN HAITI'S LIGNITE BRIQUETTING PROGRAM

USAID began investigating the worldwide prospects for coal briquetting as a substitute for fuelwood in early 1985 (see Perlack, et al.). Simultaneously, the Government of Haiti, through its Ministry of Mines and Energy Resources (MMRE), was considering the idea. Assistance was arranged for MMRE through USAID, with several groups joining the research effort. Several assessments needed to be made, including a resource assessment, a technological assessment, a market assessment, and an institutional and government policy assessment.

For the resource assessment, the work performed by the German Federal Institute for Geologic and Material Sciences was relied upon for reserve estimates, although much work could still be done in the Maissade. The U.S. Geological Survey visited the site in May, 1985, to sample 300 kilograms of lignite for analytic and laboratory testing (see Weaver).

The technological assessment of the Haitian lignite has been performed by the University of North Dakota Energy Research Center (UNDERC) and the East-West Center in Hawaii. UNDERC utilized the 300 kg sample collected from the Maissade to analyze the coal chemically and experimentally produce briquettes. Various combinations of ingredients were tried, and the formulation that produced the preferred briquette included Maissade lignite (pyrolyzed at 760 degrees C), bagasse (the cellulose by-product from sugar cane milling), water, borax, sodium nitrate, calcium hydroxide, and Haitian molasses. UNDERC also devised two production scale briquetting plant designs for different rates of output and estimated the capital costs for each (see Hauserman and Johnson). These estimates are the basis for capital costs in the current report.

Other work under the technological assessment has been performed at the East-West Center in Hawaii. The Resource Systems Institute within the Center tested the briquette produced by UNDERC for emissions that may be harmful to human health--in particular, carbon monoxide, sulfur dioxide, and total suspended particulate matter. Comparisons were also made with emissions from the current primary residential fuel, charcoal. The Resource Systems Institute used Haitian traditional stoves, an improved Haitian traditional stove, and a scientific combustor in their evaluations and comparisons of charcoal with its potential substitute of a lignite briquette. Results indicated that carbon monoxide and total suspended particulate emissions from the coal briquettes were lower than those resulting from charcoal, and room concentrations were within U. S. standards. Sulfur dioxide emissions, however, were higher than those resulting from charcoal and represented at best a borderline case compared to U.S. one hour standards for sulfur dioxide concentrations.

Oak Ridge National Laboratory (ORNL) has undertaken the market and financial assessment and the institutional and government policy assessment, the results of which are the subject of this report. The JDS Group of Cambridge, Massachusetts, has assisted ORNL in this work. These latter two organizations have worked extensively in Haiti, as well as

staying in contact with the other organizations mentioned above, to analyze the economic and social aspects of coal briquetting in Haiti.

1.4 OVERVIEW OF THE REPORT

The remainder of the report is divided into four chapters. Chapter 2 describes the market assessment, including methods and results for market size in the commercial and residential sectors. It also contains a discussion of the current fuel distribution system. Chapter 3 handles the business and financial aspects of introducing a coal briquette in Haiti, including Haitian private sector reactions to the idea. Chapter 4 reviews institutional and government policies that could affect this venture. Chapter 5 gives conclusions and recommendations. Three appendices give details on survey samples, secondary results, and conversion factors.

1.5 DEFINITION OF FUELWOOD

Following Conway (1979), a distinction will be made throughout this document between firewood and fuelwood. Firewood will be understood to mean untransformed wood. Fuelwood will be understood to mean both firewood and charcoal.

2. MARKET ASSESSMENT

This chapter details the methods and results of the market assessment for coal briquettes. The potential market size for coal briquettes is estimated by usage of fuels for which coal briquettes might substitute--wood and charcoal. Two main sectors constitute the current market for these fuels, the residential and the commercial sectors. Also described in this chapter is an evaluation of the distribution systems for these fuels, which was carried out in conjunction with the market assessment.

We will focus on the Port-au-Prince wood and charcoal markets because the city is Haiti's largest, concentrated market, prices are highest here, and sales to other markets would not tip the scales in favor of coal briquetting if the product is uneconomic in Port-au-Prince.

2.1 METHODS

Because very little secondary source data existed for the market assessment, data were gathered chiefly by survey. The three separate sectors--the residential sector, the commercial sector, and the distribution network--were each surveyed with separate questionnaires. Personnel from the Haitian Ministry of Mines and Energy Resources (MMRE) performed the interviewing in all three sectors. A summary of methods for each sector follows.

2.1.1 The Residential Sector

2.1.1.1 Purpose

Our goals in the residential sector were to survey:

- Amounts of fuels used
- Prices paid
- Uses of the fuels, and
- Consumer preferences regarding fuel characteristics

2.1.1.2 The Questionnaires

In order to obtain as large a sample as possible, two survey forms were used--a short form and a long form. The short form questionnaire asked basic questions for which a large sample was necessary to gain sufficient confidence in the estimates. These included type(s) of fuel used, prices paid, amounts used per week, place of purchase, type(s) of stove used, and number of adults and children in the family. The long form included all questions from the short form, but also contained questions on seasonal variations in prices and quantities used, price variations by types of charcoal, techniques and preferences of fuel use, characteristics of equipment used (price, age, expected life), and

whether there are additional costs to fuel use such as transport charges. The long form also contained questions enquiring about more extensive demographic information.

2.1.1.3 The Sample

The total sample size was 142: short forms numbered 110 and long forms 32. Four questionnaires had missing data on quantity used, so for analyses involving quantities of fuels--such as the market size estimates--the sample size was reduced to 138.

The sample was stratified geographically and by income level across Port-au-Prince. Port-au-Prince and the suburb of Petionville were divided into twenty-eight neighborhoods and sampled in each. Three income groups were considered--poor, medium, and rich--and they were divided among the neighborhoods in rough proportion to the numbers of each income class found in each neighborhood. Finer income categories could not be defined because people would not respond to questions on income with any degree of truthfulness. The judgement of the interviewer determined which households might be considered poor, medium, and rich in a neighborhood, and which should be chosen.

On this basis, poor households represented 51% of those interviewed, medium represented 36%, and rich households totaled 13%. These percentages undoubtedly overrepresent the proportion of medium and rich households in Port-au-Prince, but to obtain adequate numbers of households in these income categories at least these numbers of families had to be interviewed. The scale up to full market size does not use these percentages as the proportions of poor, medium, and rich families in Port-au-Prince.

2.1.1.4 Scaling Up to a Market Estimate

Our approach to estimating the residential charcoal market in Port-au-Prince utilized average household charcoal use rates by income class derived from our surveys. Using these average use rates and average family size by income group also derived from our survey, scale-ups were based upon the population of Port-au-Prince and a sensitivity analysis on estimated proportions of poor, medium, and rich households. More complex statistical procedures for scaling up (more complex subsample stratification, regressions, etc.) were impossible due to nonexistent secondary source demographic information.

A 1985 estimate of the Port-au-Prince population was obtained by revising 1982 census data for population growth and a likely 10% undercount in the census (Institut Haitien de Statistique et D'Informatique; USAID/Haiti). The resulting 1985 estimate was 882,000. A further adjustment was made to this 1985 population estimate to reflect inherent biases towards overestimation of charcoal used. Even though virtually everyone is a user of charcoal, not all Port-au-Prince residents are effective purchasers of charcoal (e.g., servants eating in their patron's household, people purchasing food from street vendors, and extremely poor people not even eating on certain days). Also, the survey data may involve some interviewer bias against surveying in the poorest

areas where use rates are lowest, as well as inherently overestimates use rates because people often say they use a sack of charcoal per week, when in fact it takes them 8 or 9 days to do so. For these reasons, it was deemed reasonable to reduce the effective Port-au-Prince population using charcoal by 20%.

Generally, use rates were quoted in terms of sacks of charcoal per week. Some of the poorer people also quoted the number of $0.10 or $0.20 "piles" of charcoal used per week. Assumptions about the weight of these different units are contained in Appendix C.

The sensitivity analysis arose via assumptions made about the proportions of the Port-au-Prince households that are poor, medium, and rich. Because different income classes consumed charcoal at varying average rates, different poor/medium/rich mixes produced different total charcoal market estimates. Calculations for five scenarios were made, ranging from a mix of 90% poor, 9% medium, and 1% rich to a mix of 60% poor, 30% medium and 10% rich.

2.1.1.5 The University of Maine Study

Below, we will compare our estimates of charcoal consumption with results from the University of Maine wood and charcoal surveys. This project progressed in parallel with the current project under another USAID contract. Twice during the course of our study and a third time subsequent to the initial drafting of our report, the University of Maine set up "dragnet" surveys of all wood and charcoal entering Port-au-Prince. People remained posted at five major access points to Port-au-Prince in July, 1985, and six access points in January, 1986, keeping watch 24 hours a day for 7 consecutive days each time. The surveyors stopped all trucks, cars, carts, and animals entering the city, and inquired about the amount of wood and charcoal aboard. From this they obtained an estimate of the number of sacks of charcoal entering Port-au-Prince. Estimates of annual importation rates can be derived from these counts.

2.1.2 The Commercial Sector

2.1.2.1 Purpose

Our objectives for the commercial sector were to estimate:

- Amounts of firewood used
- Amounts of charcoal used
- Prices paid
- Equipment used

Several industries were identified as users of wood, including bakeries, dry cleaners/laundries, school canteens, essential oils plants, and distilleries. Restaurants and street food vendors ("manger cuit") are users of charcoal.

The essential oils plants and the distilleries had been surveyed by MMRE prior to the initiation of this study (La Roche and Kooi; Barkley Byess). The school canteens were in the process of being surveyed during the fall and winter of 1985/86. This report uses the information from these sources for these industries. For the bakeries, dry cleaners, and restaurants, surveys were initiated under this study. Again, personnel in MMRE actually conducted the interviews.

2.1.2.2 The Questionnaires

Short and long form questionnaires were used also in the commercial sector to obtain a sufficient sample size on essential numerical data, and answers to more qualitative or less important questions from a smaller sample. The short form asked what type of fuel was used, the amount used per week, units in which purchased, the price paid, where purchased, and firm-specific data on size. The long form again included all questions on the short form, but also asked more specific questions about usage patterns, seasonal variations, price variations by type of wood and charcoal, costs, equipment, and desirable qualities of a fuel.

2.1.2.3 The Sample

Tax lists were obtained for each industry from the Haitian General Directorate for Taxation. Twenty percent of the firms in Port-au-Prince in each industry were sampled randomly. However, it was found that the tax lists were out of date, and many businesses had closed. Missing data also plagued the survey. Replacements for closed businesses were selected, and in general, the attempt was made to gather information on as many establishments as possible to reduce the missing data problem. Replacements were drawn from the same sector of the city to avoid geographic biases, but some violation of randomness in firm size may have occurred. This would not affect our results due to the way that we segmented our sample by size for analysis. In the end, more than 20% of the industry in both the dry cleaners and bakeries were surveyed. Fewer than the desired number of restaurants were interviewed, particularly street vendors. Forty of 146 bakeries, 30 of 94 dry cleaners, 32 of 144 restaurants, and 14 street vendors were interviewed. For a more complete breakdown of the commercial sample, see Exhibit A-1, Appendix A.

The school canteens scattered across the entire country had been only partially surveyed at the time of writing. Ninety-five out of an intended sample of 180 surveys had been completed. Surveying had occurred in 6 of the 9 Haitian "departements" (provinces). Thus, estimates were based only upon a partial sample, and we assumed that school canteens in unsurveyed areas were not significantly different than those included. Since the one area qualitatively different from other areas, Port-au-Prince, was included, it could be segregated. Then the other surveyed areas could be assumed to represent the entire country. Estimates for the whole country were made since the canteens represent a captive market that USAID might direct to use coal briquettes. (See Exhibit A-2, Appendix A.)

2.1.2.4 Scaling Up to a Market Estimate

Market estimates were made for bakeries and dry cleaners by segmenting firms into those that buy wood by the truck load, those that buy by the 100 pieces, and those that use other fuels (natural gas or fuel oil). The wood groupings are important because wood bought in different units commands significantly different prices per unit weight. To perform the scale-up, average wood usage rates were estimated for each subgroup and applied to the same proportion of the population as we found in the sample. Population sizes were assumed to be the number of firms found on the government tax lists even though some firms were out of business. It was assumed that the same number of firms had entered the industry as had left it.

For the restaurants, an estimate of total charcoal use was performed by Clarence Kooi, USAID Resident Energy Advisor to MMRE, utilizing the data from the restaurant surveys. He performed a simple scale-up using average charcoal consumption from the restaurants surveyed times the number of restaurants in Port-au-Prince. The resulting amount of charcoal used was small, so we made no further refinements.

Because the actual number of street vendors is unknown, we performed a sensitivity analysis, postulating five possible numbers of vendors between 100 and 2000 in Port-au-Prince. Average charcoal consumption rates were applied to these hypothetical numbers of vendors to obtain an idea of their total use.

For the school canteens, we made very rough estimates for the country as a whole and for the Department of the West, in which Port-au-Prince is situated. Most canteens in the former group use wood. In the second group, half of the canteens use charcoal. The whole country estimate was the sum of an estimate for the Department of the West and an estimate for all other Departments combined. Both estimates were based strictly on average wood and charcoal usage rates.

Conversion factors to translate volumes of wood and charcoal (truck loads, bundles of 100 pieces, sacks, piles, etc.) into tonnes of wood and charcoal, as well as heat equivalency factors are given in Appendix C.

2.1.3 The Distribution Systems

2.1.3.1 Purpose

Understanding the distribution systems was necessary in order to (1) evaluate the economic competitiveness of a coal briquette, (2) determine whether the current distribution systems could support distribution of the briquette, and (3) if so, where in the chain should the product be introduced. To meet these objectives questions needed to be asked to:

- Determine prices of wood and charcoal at various points in the distribution chain
- Determine costs of transportation and middlemen's margins

- o Evaluate the suitability of the current distribution systems for distributing a coal briquette

2.1.3.2 The Questionnaires

To characterize the distribution chain, questions were asked from whom was the fuelwood bought and to whom sold (a producer, transporter, wholesaler, or retailer?), source and destination, and means of transportation. To obtain prices and margins, each interviewee was asked buying price, selling price, volume, margin, and costs incurred. Seasonality effects and variations by charcoal or wood type were also inquired about. Whether the distribution systems would resist taking on a coal briquette was addressed through questions on competitiveness and degree of vertical integration of the industry, such as whether the business was personal or corporate, whether the fuelwood trader bought from or sold to a family member, and whether cash or credit is employed. Also to help determine the suitableness of the current network for coal briquettes, we asked the interviewee if he or she would handle the product.

2.1.3.3 The Sample

Four primary groups constitute the charcoal and wood distribution networks: producers, transporters, wholesalers and retailers. The latter three groups were interviewed. Time constraints precluded interviewing the producers.

Participants in the fuelwood distribution chains were interviewed both inside and outside of Port-au-Prince. This allowed us to tie together the supply chains from the provinces into Port-au-Prince and obtain a rough value-added structure. Target numbers of interviewees were set by geographic location and market, and the choice of interviewee was left to the interviewer. The numbers of each type of charcoal supplier in the final sample are contained in Exhibit A-3. Exhibit A-4 contains similar information for the wood suppliers.

2.2 RESULTS

2.2.1 Market Size

2.2.1.1 Overall Results

The results of scaling up all sectors indicate that the charcoal market is by far the largest potential market in Port-au-Prince for a coal briquette. We estimate that this market measures on the order of 100,000 to 120,000 tonnes per year. The penetrable wood market, on the other hand, appears to be only about 6,000 tonnes of charcoal equivalent per year (that is, about 12,000 tonnes of wood).1/

The derivation of these results by sector follows.

1/Wood has about half the heat content per tonne as does charcoal.

2.2.1.2 The Residential Sector

If charcoal provides the largest potential market for the coal briquette, then the residential sector contributes by far the largest portion to this market. Residential fuelwood in Port-au-Prince is virtually 100% charcoal; only insignificant amounts of wood are burned for cooking in the capital city. Thus, the Port-au-Prince charcoal market represents the largest potential market for a coal briquette, and its size makes it large enough to support a coal briquette if the briquette can compete on price, which is explored in Chapter 3.

By scaling up the household survey data, we obtained estimates of residential charcoal usage between 115,000 and 131,000 tonnes per year (see Exhibit 2-1). This is based upon the sensitivity analysis of the proportions of poor, medium, and rich classes. In our judgement, the income proportions of Scenarios 2 through 4 are most likely, with estimated charcoal consumption between 120,000 and 126,000 tonnes per year. However, these estimates are not taken as our final estimates. Before we give final estimates, we wish to review the University of Maine data, which suggests that our estimates should be adjusted downward.

First we note that the estimates in Exhibit 2-1 are based upon an interesting result from the household survey. We found that the poorer families used less charcoal per week than did the medium income group, which in turn used less than the high income group. This is a bit surprising because average family sizes tend in the opposite direction (see Exhibit B-1, Appendix B). Moreover, with the availability of electricity and bottled gas, one might postulate that charcoal is merely the poor man's fuel. However, average use rates running higher as income increases, despite dwindling family size, indicates that charcoal has a positive income elasticity in Haiti and is not just the poor man's fuel.

Exhibit 2-1. Household Survey Scale-Up Estimates of Residential Charcoal Consumption in Port-au-Prince

Scenario	Income Group Proportions (Poor/Medium/Rich)	Estimated Charcoal Market (metric tons/year)
1	.90/.09/.01	114,700
2	.80/.15/.05	120,400
3	.70/.25/.05	125,400
4	.70/.20/.10	126,400
5	.60/.30/.10	131,400

2.2.1.3 The Commercial Sector

In the commercial sector, the primary wood fuel is firewood. We found that larger commercial establishments, measured in terms of product output, tended to use diesel. Smaller ones used firewood. Larger wood users bought by the truck load and smaller ones by the 100 pieces.

The results of scaling up all industries indicate that the Port-au-Prince commercial sector represents a market of about 20% the size of the residential charcoal market on a Btu equivalency basis. However, only about one-half to three-quarters of this represents any potential market for a coal briquette.

We estimate that about 26,000 tonnes of wood are consumed per year by the bakeries, dry cleaners, and school canteens in the Port-au-Prince area. However, only about 12,000 tonnes of this would represent a possibly penetrable market for a coal briquette. The rest is purchased by the truck load at a price approximately 33% below the price at which wood trades when sold by the 100 pieces, and this price is too low for a briquette to compete. (More discussion on prices is given below.) The potentially penetrable part of the wood market represents about 6,000 tonnes of charcoal on a heat equivalency basis.

Further, our judgement is that, at most, between 2,300 and 12,500 tonnes of charcoal are consumed by the street vendors, restaurants, and school canteens, with the middle of this range being most plausible. The range is large because the number of street vendors in Port-au-Prince is unknown. Details on the sensitivity analysis for the street food vendors are in Appendix B.

Summing the 6,000 tonnes of charcoal equivalent burned as wood and the 2,300 to 12,500 tonnes of charcoal consumed gives a total, potentially penetrable Port-au-Prince commercial market for a coal briquette of 8,000 to 18,000 tonnes of charcoal equivalent. Again, the middle of this range is most likely. Exhibit 2-2 contains a summary of these results.

Outside Port-au-Prince, several industries consume wood, including the essential oils plants, the distilleries, and the school canteens. Wood consumption in these industries totals approximately 186,000 tonnes per year for all of Haiti (see Exhibit 2-3). However, this market does not constitute a prime target for coal briquettes, because the prices paid for wood are too low in the countryside, and the dispersed nature of the industries would make delivery of coal briquettes expensive. Only the school canteens, if they are required to use coal briquettes by government policy, might be a target market. However, they represent only 10% of the wood consumed in these three industries; also, this philanthropic effort would be forced to pay higher prices than they do for their current fuel, unless their briquette purchases were subsidized.

Exhibit 2-2. Estimates of Commercial Sector Wood and Charcoal Consumption in Port-au-Prince.

Industry	Low Priced* Wood (Tonnes/yr)	High Priced** Wood (Tonnes/yr)	Charcoal (Tonnes/yr)	Maximum Penetrable Mkt (Equiv. tonnes charcoal/yr)
Bakeries	8,780	2,780		1,390
Dry Cleaners	4,860	7,440		3,720
School Canteens		1,700	1,400	2,250
Restaurants			390	390
Street Food Vendors			535-10,700#	535-10,700
TOTALS	13,640	11,920	2,325-12,490	8,300-18,500 (rounded)

*Wood bought by truck load
**Wood bought by 100 pieces or other small units
#Based upon there being between 100 and 2000 street food vendors in Port-au-Prince. Actual number of food vendors is unknown. See Appendix B for details.

Exhibit 2-3. Wood Consumed in Industries Mainly Outside of Port-au-Prince (Estimates for All of Haiti).

Industry	Wood Consumption (Tonnes/year)
Essential Oils	31,400
Distilleries	135,300
School Canteens	19,500*
TOTAL	186,200

*Includes 1,700 tonnes for Port-au-Prince cited in Exhibit 2-2.
Sources: Essential Oils: La Roche and Kooi
Distilleries: Barkley Byess
School Canteens: Estimate by authors based upon partially completed school canteen surveying

2.2.1.4 Conclusion on Market Size

Survey method results

The unadjusted estimate of market size from the residential survey scale-up was 114,300 to 131,400 tonnes of charcoal per year. Adding the estimated range of commercial charcoal of 2,300 to 12,500 (Exhibit 2-2) gives a total Port-au-Prince charcoal market estimate of 117,000 to 144,000 tonnes per year. This is above the estimates derived from the University of Maine data, which will now be discussed.

University of Maine estimates

The University of Maine count of sacks of charcoal imported to Port-au-Prince amounted to approximately 43,600 sacks in one week in July, 1985, where the sacks were not differentiated by size. In January, 1986, preliminary results showed 29,390 large sacks and 6,690 small sacks imported in one week.2/ We estimate that this amount of charcoal would correspond to 76,000 tonnes of charcoal per year based on the January count and 92,200 tonnes per year based on the July count.3/ Thus, with the caveat given in the next paragraph, we might consider Port-au-Prince charcoal use estimates based upon University of Maine data to range between 76,000 and 92,200 tonnes per year.

While the estimates we derived from the University of Maine data were adjusted to take account of a probable undercount attributable to

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2/We very gratefully acknowledge the release of this information before the University of Maine had written their report, which was completed in the spring of 1986 (see Grosnick and McGowan). The results used here were preliminary at the time of our writing, and the interested reader should refer to the University of Maine report for final estimates of charcoal imports to Port-au-Prince. The estimates in their report benefited from a third "dragnet" survey in the spring of 1986. We have not adjusted our estimates because the spring, 1986 "dragnet" gave results similar to adjusted results from the summer of 1985.

3/These are our estimates based upon University of Maine data. Responsibility for these figures should not be attributed to the University of Maine, as we made assumptions and calculations to arrive at them. The University of Maine admittedly missed one major entrance route in their July count, by our estimates undercounting large sacks by 1.2% and small sacks by 32.7%. In addition, we believe that the "dragnet" survey method tends to underestimate charcoal imports by missing minor entrance routes, by owner underreporting due to suspicion about taxes, and because of inaccurate knowledge by the truck drivers. To account for these biases, we adjusted the July count up by 10%. In addition, the January count was conducted in a nonrepresentative period characterized by poor weather and political unrest, so we adjusted this count up by a further 5% (total of 15%). The results were 92,200 and 76,000 tonnes of charcoal for the July 1985 and January 1986 counts, respectively.

political problems and other factors in the country during the January, 1986 count, these results run counter to evidence on seasonality derived from our survey of the charcoal wholesalers and retailers. These individuals indicated that their slow sales months occurred in June through August and peak sales occur in October through January. The questions arise whether the upward adjustment that we made to the January count is insufficient and whether the July figure is the real floor on the amount of charcoal imported. This suspicion receives added weight from the final University of Maine count, which was made after calculations for this report were completed, and was similar to the summer of 1985 count.

Conclusion on charcoal market size

Exhibit 2-4 gives a comparison of the Port-au-Prince charcoal market estimates based on data from the ORNL household survey and on the University of Maine charcoal import surveys. Because the ranges on the estimates still differ, even after both estimates have been adjusted for over- or undercounting, our approach is to take a middle set of numbers to estimate actual charcoal market size for Port-au-Prince. Thus, our best judgement range on the 1985 Port-au-Prince charcoal market is 100,000 to 120,000 tonnes of charcoal per year.

Numbers with this degree of accuracy are sufficient for our current purposes. First, they indicate that the charcoal market is much larger than anything reported by previous authors, even if we project their figures to the present using their growth rates (see, for example, Voltaire). Thus, we believe that former estimates based upon government data were underestimates of the true charcoal market. Second, the general range of market size gives a good idea of the size of a charcoal briquetting plant that could be supported; one does not need a point estimate, but only to know that the market is "large enough" to support a plant of a particular size.

We did not estimate the amount of charcoal consumed outside Port-au-Prince. We believe that the coal briquette would have to prove economic on the basis of the Port-au-Prince market, and therefore such a calculation is unnecessary. Others have estimated that Port-au-Prince charcoal consumption represents one-half of the country's total, although these estimates are dated (Earl; Voltaire).

Overall conclusion on market size

Exhibit 2-5 summarizes the residential and commercial estimates of market size in tonnes of charcoal equivalent per year. We have adjusted the residential market size downward from our household survey estimates (Exhibits 2-1 and 2-4) to reflect the smaller overall charcoal market indicated by the University of Maine data. Exhibit 2-6 depicts the relative proportions of the components of the potential coal briquette market in Port-au-Prince.

Exhibit 2-4. Comparison of Port-au-Prince Charcoal Market Estimates.

Data Source	Low Estimate (Tonnes/year)	High Estimate (Tonnes/year)
ORNL	117,000	144,000
Univ. of Maine*	76,000	92,000

*Not official University of Maine estimates. Calculated from data released to the authors by the University of Maine.

Exhibit 2-5. Summary of Potential Penetrable Market Results (in Tonnes of Charcoal Equivalent, Rounded)

Sector	Potential Penetrable Market (Tonnes of Charcoal Equivalent)	
TOTAL CHARCOAL		100,000-120,000
Residential Charcoal	95,000 - 110,000	
Commercial Charcoal	2,300 - 12,500	
TOTAL WOOD (Commercial Wood)		6,800
TOTAL POTENTIAL MARKET (Rounded)		105,000-125,000

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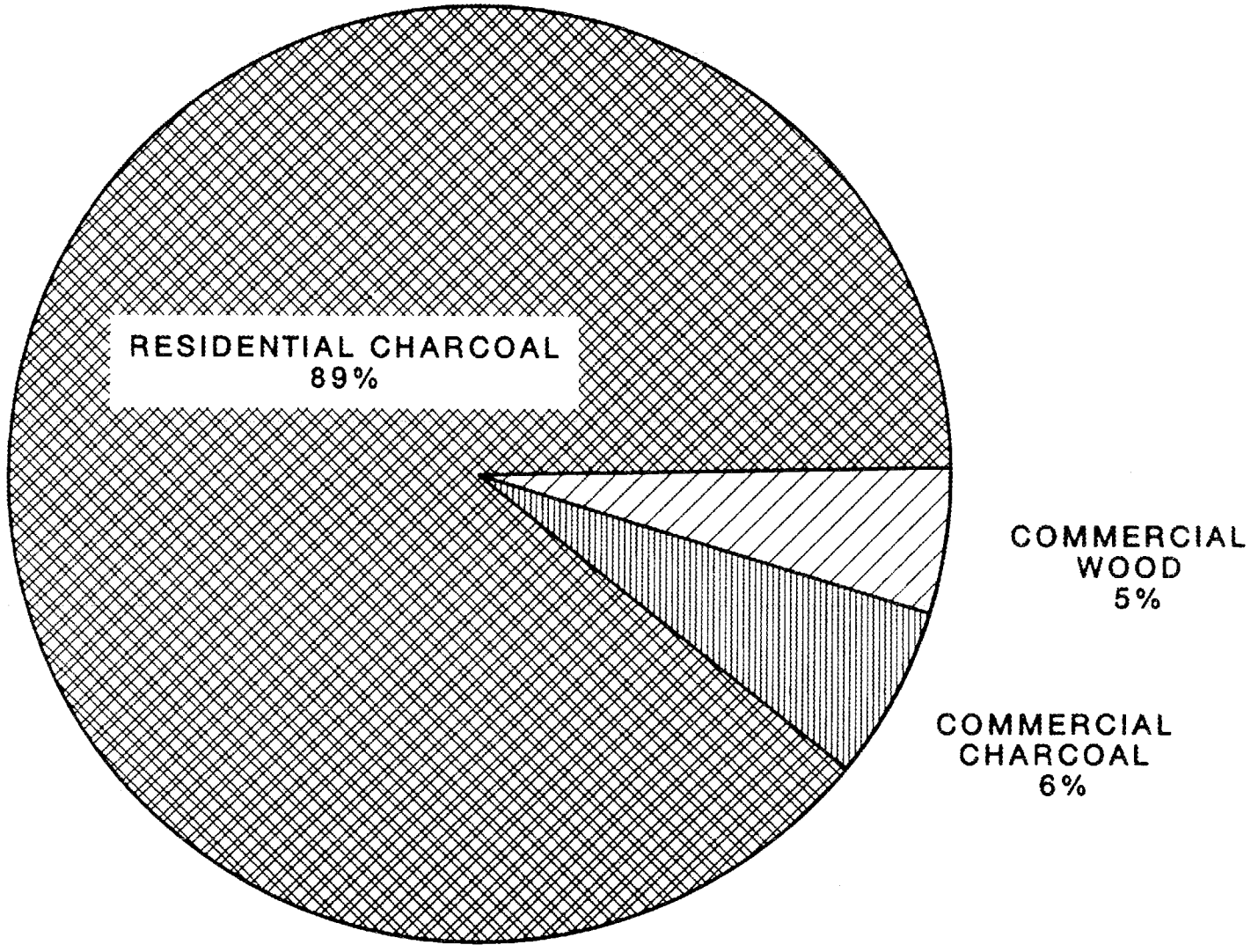
EXHIBIT 2-6. PROPORTIONS OF POTENTIAL COAL BRIQUETTE MARKET IN PORT-AU-PRINCE



NOTE: PERCENTAGES ARE ON A HEAT EQUIVALENCY BASIS, NOT ON TONNES OF WOOD AND CHARCOAL

2.2.1.5 Market Penetration for a 50,000 Tonne per Year Plant

Given a market size of 105,000 to 125,000 tonnes of charcoal equivalent in the Port-au-Prince area, a 50,000 tonne per year coal briquetting plant would satisfy 25% to 40% of the market. The proportion of the market that briquettes from that size plant would satisfy depends on the heat content of the briquette chosen for manufacture. A lower heat content per kilogram means that 50,000 tonnes per year would cover a smaller portion of the market. Thus, the Maissade lignite briquette would satisfy a smaller proportion of the market, perhaps a quarter to a third, than would either a L'Azile lignite briquette or an imported coal briquette, which would satisfy a third to 40%. Exhibit 2-7 illustrates how a production rate of 50,000 tonnes per year of the various briquettes would fulfill different proportions of the potential market.

2.2.2 Fuel Prices from the Residential and Commercial Surveys

2.2.2.1 Residential Charcoal Prices

Our residential survey provided information on retail charcoal prices by market area in Port-au-Prince. Averages of this information are given in dollars per tonne in Exhibit 2-8. Exhibit 2-12 is a city map presenting similar information from the distribution network surveys. In general, the Exhibits indicate how the retail price of charcoal increases as one moves from the primary wholesale markets of Cité Simon and Carrefour to the wholesale market downtown (Croix des Bossales), and then to the retail markets up the hillside towards Petionville. The anomalies to this pattern undoubtedly occur because some averages are based on only a few observations. Exhibit B-3 gives equivalent information in the local currency (gourdes) and local units of measure (piles, small, and large sacks).

2.2.2.2 Wood Prices

We found that wood purchased by the truck load averaged between $23.05 and $23.60 per tonne for the dry cleaners and bakeries in Port-au-Prince. Wood purchased by the 100 pieces averaged between $37.20 and $43.60 per tonne. While the former is approximately one-half the wholesale buying price of charcoal on a heat equivalency basis, the price of wood purchased by the 100 pieces approaches the price of wholesale charcoal on the same basis.4/ Thus, because we chose the wholesale charcoal buying price for calculating an entrance price for a coal briquette, only wood purchased in small units provides a possible market for the new product.

See also the discussion on wood prices in the section on the Wood Distribution System below (2.2.4.3).

4/By choosing heat equivalency as the basis of comparison, we implicitly assume that the burning characteristics of wood, charcoal, and a coal briquette are equivalent. This is not necessarily true in all applications. Only actual trials can substantiate the compatibility of the briquettes with existing equipment and cooking/heating methods.

Exhibit 2-7. Proportions of Potential Market Served by a 50,000 Tonne per Year Coal Briquetting Plant

Type of Briquette	Assumed Briq. Heat Content (kcal/kg)	Tonnes of Briq. for 100% of Mkt.*	Portion of P-au-P Mkt Served by 50,000 TPY Plant*
Maissade	4230	190,000	26%
L'Azile (best sample)	5500	146,000	34%
Imported High Volatile	6445	125,000	40%
Imported Low Volatile	6230	129,000	39%

*Assuming a potentially penetrable residential and commercial Port-au-Prince market of 115,000 tonnes of charcoal equivalent per year and 7000 kcal/kg heat content for charcoal.

Exhibit 2-8. Retail Charcoal Prices in Port-au-Prince in Dollars per Metric Ton.

	Price in $/Tonne by Unit of Purchase		
Market	Pile**	Small Sack**	Large Sack**
Outside P-au-P*		101.86	120.07
Cité Simon (Wharf)			109.21
Carrefour			120.39
Croix des Bossales/ La Saline			125.66
Marché Salomon			126.49
Poste Marchand			142.11
Delmas Markets	235.68		144.21
Other P-au-P Markets		164.13	137.25
Petionville			150.00

*Prices for purchases by Port-au-Prince consumers when they are in the provinces and they bring the charcoal back to Port-au-Prince

** Piles = approximately 0.45 kg ($0.10 pile) or 0.90 kg ($0.20 pile)
Small sack = 23 kg
Large sack = 38 kg

2.2.3 Qualitative Market Aspects

2.2.3.1 Residential Uses of Charcoal

The uses of charcoal fall by far into two categories: (1) simmering food and (2) heating an iron for ironing clothes. The latter use may actually utilize waste heat after a meal. Other uses, such as frying or grilling food were not mentioned often by consumers. Thus, Haitians largely use charcoal for boiling or simmering something in a pot. One might conclude that not much charcoal flavor is imparted to the food, and introducing a coal briquette would not cause taste changes that would limit its acceptability. However, opinion from Haitians with whom the

authors have talked is that taste changes would cause problems. Only a consumer test can confirm or deny taste-related limitations.

We found that Haitians often add charcoal to the fire in the course of cooking the midday meal, the main meal of the day. This may give an advantage to a coal briquette, which will probably have a longer burning time, and would thus be required in smaller amounts.

2.2.3.2 Desirable Characteristics of a Domestic Fuel

We asked residential respondents to rank as "unimportant," "moderately important," or "very important," a list of characteristics of fuels. Overall, respondents indicated at the top of their list that lack of smoke and easy ignition are the most important qualities of a fuel. Calorific content and price are next most important. The amount of ash was important only to about half of respondents.

The method of igniting the charcoal used by almost all respondents involves using a small amount of wood kindling. This method also proved successful in igniting Haitian coal briquettes in the UNDERC laboratory (see Hauserman and Johnson, p. 14).

2.2.3.3 Residential Stoves

The most widely used stove among the poor is the circular charcoal stove, which 57.7% of respondents in this income category use. Among medium income households, the multiple-hearth charcoal stove (both masonry framed and iron framed) is the most popular. In the rich class, multiple-hearth, masonry framed and natural gas stoves are most widely used, each being used by 55.6% of the population. Exhibit B-4 summarizes all information on the types of stoves used by income category.

The introduction of a coal briquette would not be hampered by the type of stove used for charcoal. The University of North Dakota tested the Maissade briquette in the Haitian circular and square charcoal stoves. The briquettes burned acceptably. Moreover, even if stove replacement improves burning efficiency, the turnover rates for the most common circular and square single-hearth stoves are very quick and their cost is low. From our survey, the average price of a traditional circular stove is 6.40 gdes ($1.28) and of a traditional square stove 5.50 gdes ($1.10). The circular stove has an average life of 5 1/2 months, whereas the square version lasts about 3 1/2 months.

2.2.3.4 Types of Charcoal Used

Many tree species are used in manufacturing charcoal. Some common types of charcoal are bayahonde (mesquite), campeche (logwood), gayak (common lignum vitae), and a mixture called "ti bwa." From our residential survey, the most widely used type of charcoal is "ti bwa." Sixty percent of our respondents said that they used this type of charcoal. Charcoal from bayahonde was used by 26% of respondents. The high grade of charcoal, gayak, which is made from a harder and now rather rare wood, was mentioned by only 4.4% of respondents. Other species, including campeche, mango, and watapana, were mentioned only 3.7% of the

time. Nineteen percent of respondents did not know the type of charcoal and 2% did not answer.5/

Prices quoted to us by both the residential sector and the wholesalers and retailers indicated that the types of charcoal can be reduced to two categories on the basis of price--gayak and all others. Gayak commands a premium of about 5 gourdes per large sack in Port-au-Prince. Since gayak is the only charcoal that differentiates itself significantly in price and it is bought by only about 5% of the population, one can conclude that the charcoal market is fairly uniformly a single-product market for purposes of introducing a coal briquette.

2.2.4 The Distribution Systems

2.2.4.1 Overview

The wood and charcoal distribution systems are complex, well-developed, and competitive networks supplying the Port-au-Prince market. Sufficient numbers of people with knowledge of distributing a product and a sufficient number of people willing to supply transportation exist to take on the task of distributing a coal briquette. The briquette might be sold into the current distribution system at the factory gate or it might be transported by the factory owner to one or more wholesale markets in Port-au-Prince. The latter possibility may yield economies of scale in transport, cutting out a middleman and saving on delivered wholesale cost.

Transportation costs from either Maissade or L'Azile are currently about 5 gourdes per large sack, or approximately $25 per tonne. Transporting large shipments from either source may bring transportation costs down. However, this is more likely from L'Azile than from Maissade, since L'Azile is connected to Port-au-Prince by better roads.

An examination of the wholesale markets for charcoal indicates that the coal briquette would have to be introduced at a price equivalent to 16 to 18 gourdes ($3.20 to $3.60) per *gros sac* ("large sack") on a heat equivalency basis. This is presently the wholesale buying price for charcoal, ignoring some seasonal variation. It equals $84.20 to $94.75 per tonne of charcoal equivalent.

These are some crucial results from our study of the distribution systems. The following sections describe more detailed conclusions, including results on prices, quantities, seasonal variation, gross margins, vertical integration, credit policies, and types of wood and charcoal sold. Charcoal and wood are described in turn.

5/Percentages do not add to 100% because some respondents mentioned more than one type of charcoal.

2.2.4.2 The Charcoal Distribution System

Description

Four primary types of players interact in the Haitian charcoal distribution system: producers, transporters, wholesalers, and retailers. A fifth actor in the system, the "collector" of charcoal was included under wholesalers in our interviewing.

The producers are by and large poor peasants. Often they produce charcoal because they have no other means of support. They may produce either intermittently, -- e.g., during the agricultural off-season -- or as a full-time occupation.

The charcoal passes from the producers in a variety of ways. The charcoal may be sold to collectors who take it to regional markets to be sold locally or to be sold into the distribution chain to Port-au-Prince. If the latter occurs, a Port-au-Prince wholesaler takes possession at this point. Alternatively, the collector may have the charcoal transported all the way to Port-au-Prince, where it is sold to a wholesaler. Yet another way is that the Port-au-Prince wholesaler will purchase directly from the producers. Finally, an occasional producer will travel with the charcoal to a market to gain the middleman's profit. The charcoal distribution system is depicted diagrammatically in Exhibit 2-9.

Transportation is provided by truck or sailboat owners largely on a fee-for-services basis. Only occasionally does the owner of a vehicle buy and resell charcoal, becoming a middleman himself. Truckers transport between 50 and 200 gros sacs at a time, and the sailboats carry 200 to 300 sacks per voyage.

Three main charcoal wholesale markets exist in Port-au-Prince, the Cité Simon Wharf, Carrefour, and Croix des Bossales. The wholesalers at these markets sell to retailers, to Port-au-Prince distributors, and occasionally directly to consumers who buy a full sack at a time. The distributors and retailers will take the charcoal to retail markets in Port-au-Prince, sometimes paying a third party for transport. Some dealers also deliver to homes. Some retailers specialize in breaking down the sacks into 0.50 gde and 1 gde ($0.10 and $0.20) piles to be sold to the poor.

More than half of the wholesalers outside Port-au-Prince sell other goods or work in other occupations. Similarly among transporters, about half transport other goods or occasionally work in other occupations. In Port-au-Prince, however, charcoal wholesalers and retailers usually pursue their work as full-time occupations.

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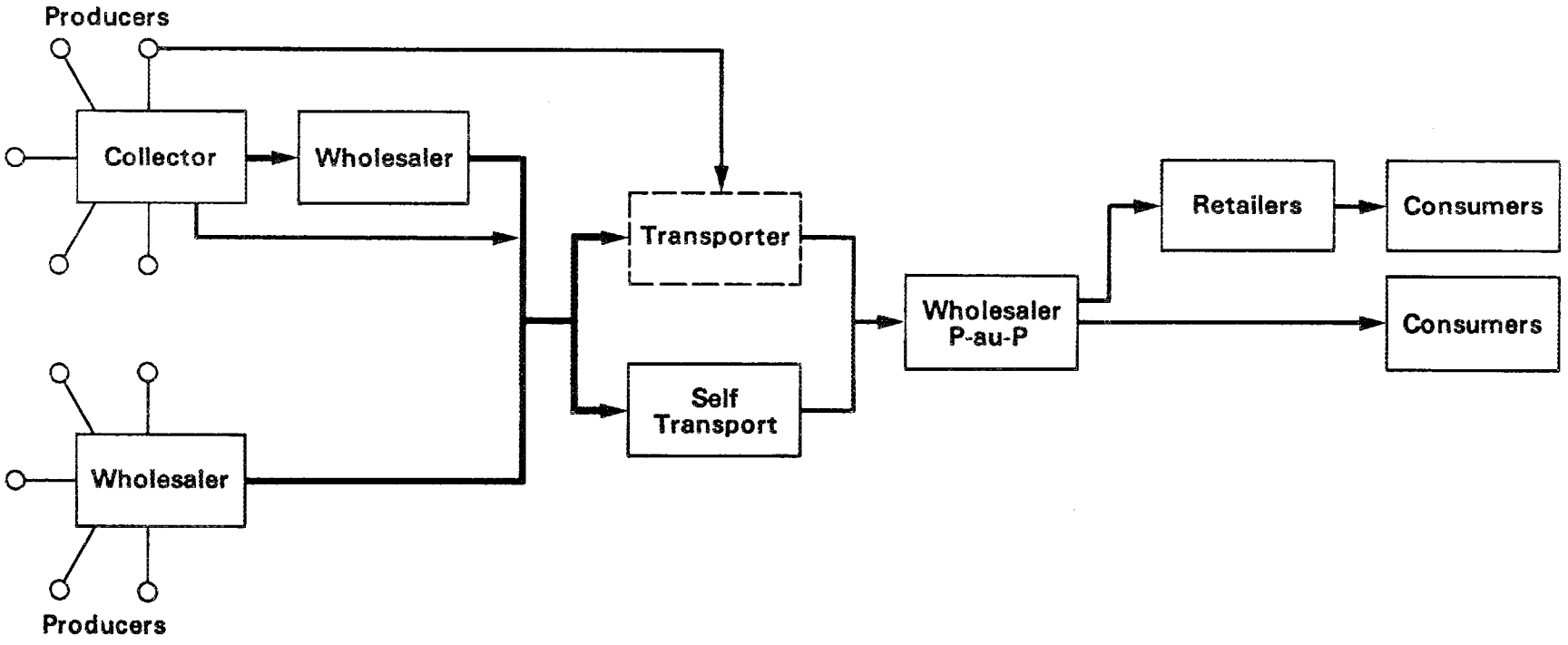
EXHIBIT 2-9. The Haitian Charcoal Distribution System to Port-au-Prince



Dotted line: Does not own charcoal.

Thick line: Main routes.

Origins of Charcoal

Preliminary data from the University of Maine indicated that the majority of charcoal originates from the Southwest and Northwest peninsulas of Haiti.6/ Unlike a few years ago, when the Northwest predominated in charcoal production, the supply to Port-au-Prince from the Southwest may be slightly larger, contributing 36% versus the Northwest's 33% of Port-au-Prince charcoal supply. The area of the Artibonite and St. Marc contribute another 15%, and additional supplies come from other areas in the country as shown in Exhibit 2-10. The Exhibit also shows the major land and sea routes for charcoal into Port-au-Prince. The two northernmost provinces contribute almost no charcoal to the Port-au-Prince market, but rather feed the Cap-Haitien market. The boundary of this separate market area is delineated in Exhibit 2-10.

Prices and Margins

There is great variability in the prices and gross margins earned by various people in the charcoal supply chain, especially depending upon how many hands the charcoal passes through. However, a general feel can be given for the costs involved in providing a Port-au-Prince consumer with a gros sac of charcoal. First, Exhibit 2-11 is a map with prices received for charcoal around the country.7/ Secondly, Exhibit 2-12 displays the prices received in various Port-au-Prince markets. It again displays how prices rise as one moves away from the wholesale markets on the waterfront to the retail markets of Port-au-Prince and up the hillside to Petionville (cf. Exhibit 2-8). Finally, the general costs behind a sack of charcoal in Port-au-Prince--where small costs such as the cost of the sack itself, loading and unloading, taxes, etc. are included in the middlemen's gross margin--are provided in Exhibit 2-13. Our work indicated that the middlemen who made the most profit were those who cut out links in the supply chain, for instance a Port-au-Prince wholesaler who bought from the producers themselves and who owned his own mode of transport.

6/The data for this paragraph and Exhibit 2-10 were taken from the University of Maine's July, 1985, survey of charcoal imports to Port-au-Prince. Surveys of January, 1986, and spring, 1986, may have revealed somewhat different results. The reader is referred to the University of Maine report from the Spring of 1986 (Grosnick and McGowan).

7/Exhibit 2-11 indicates a large difference in transportation costs by boat from the Southwest Peninsula than from the Northwest Peninsula. We cannot explain this discrepancy, but merely report the results as they came from the interviews. The number of observations in each case is small, so there may be biases in the small sample.

Exhibit 2-10. **Sources of Charcoal and Transportation Routes for the Port-au-Prince Market**

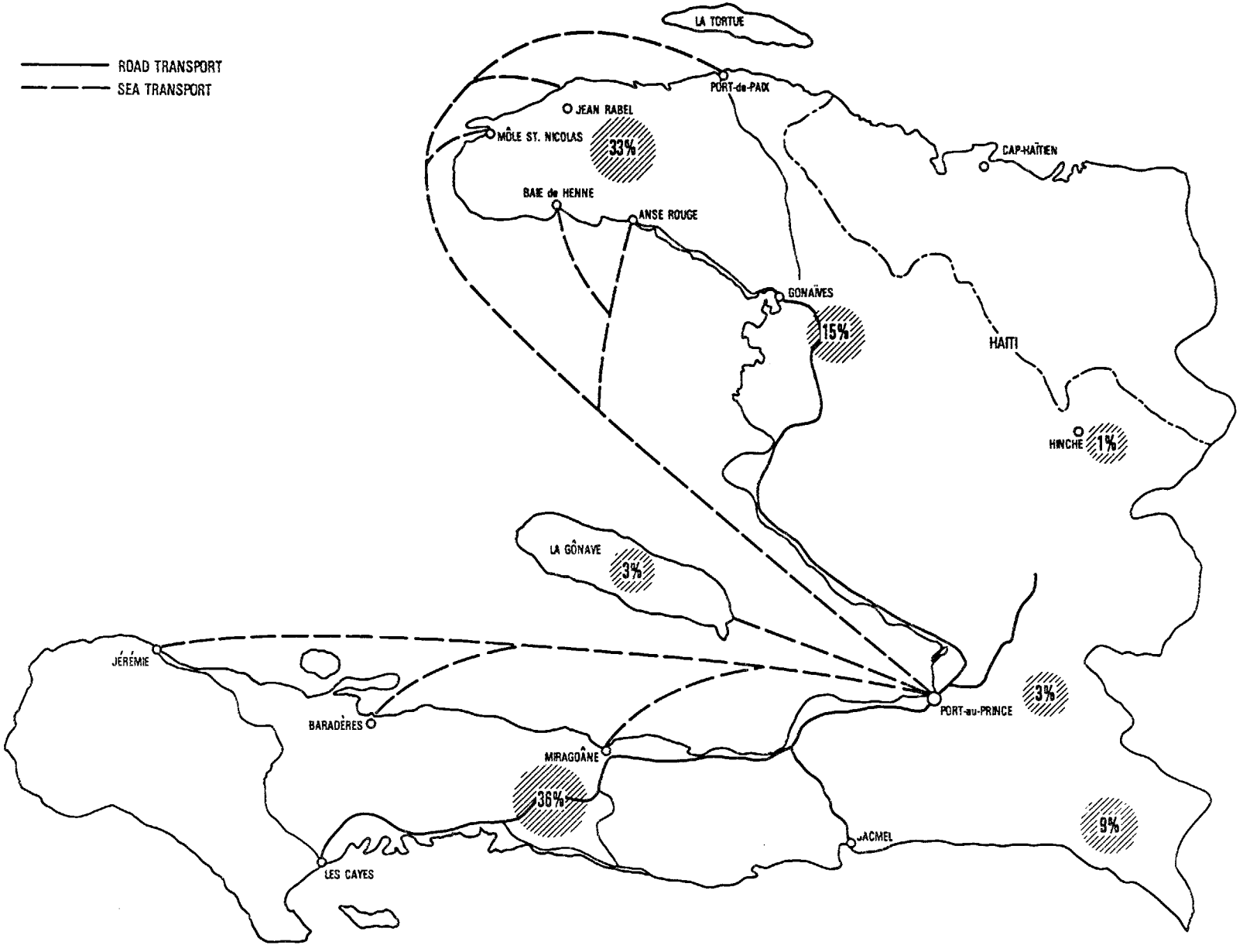


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Exhibit 2-11.

COST OF CHARCOAL AND CHARCOAL TRANSPORT IN HAITI, SPRING, 1985, IN GOURDES PER "GROS SAC" (38kg)

EXCEPT IN URBAN AREAS MARKED BY ASTERISKS, PRICES ARE THOSE PAID TO PRODUCERS NEAR THE IDENTIFIED TOWNS. CHARCOAL IS SUBSEQUENTLY TRANSPORTED ALONG INDICATED ROUTES TO PORT-AU-PRINCE. FIGURES FOR URBAN AREAS MARKED BY ASTERISKS INDICATE TRADER PRICES (OUTSIDE PORT-AU-PRINCE) OR RETAIL PRICES (PORT-AU-PRINCE). FIGURES WITH ARROWS ARE TRANSPORTATION COSTS PER "GROS SAC".

SOURCES: INTERVIEWS CONDUCTED BY MMRE AND UNIVERSITY OF MAINE AGROFORESTRY OUTREACH RESEARCH PROJECT

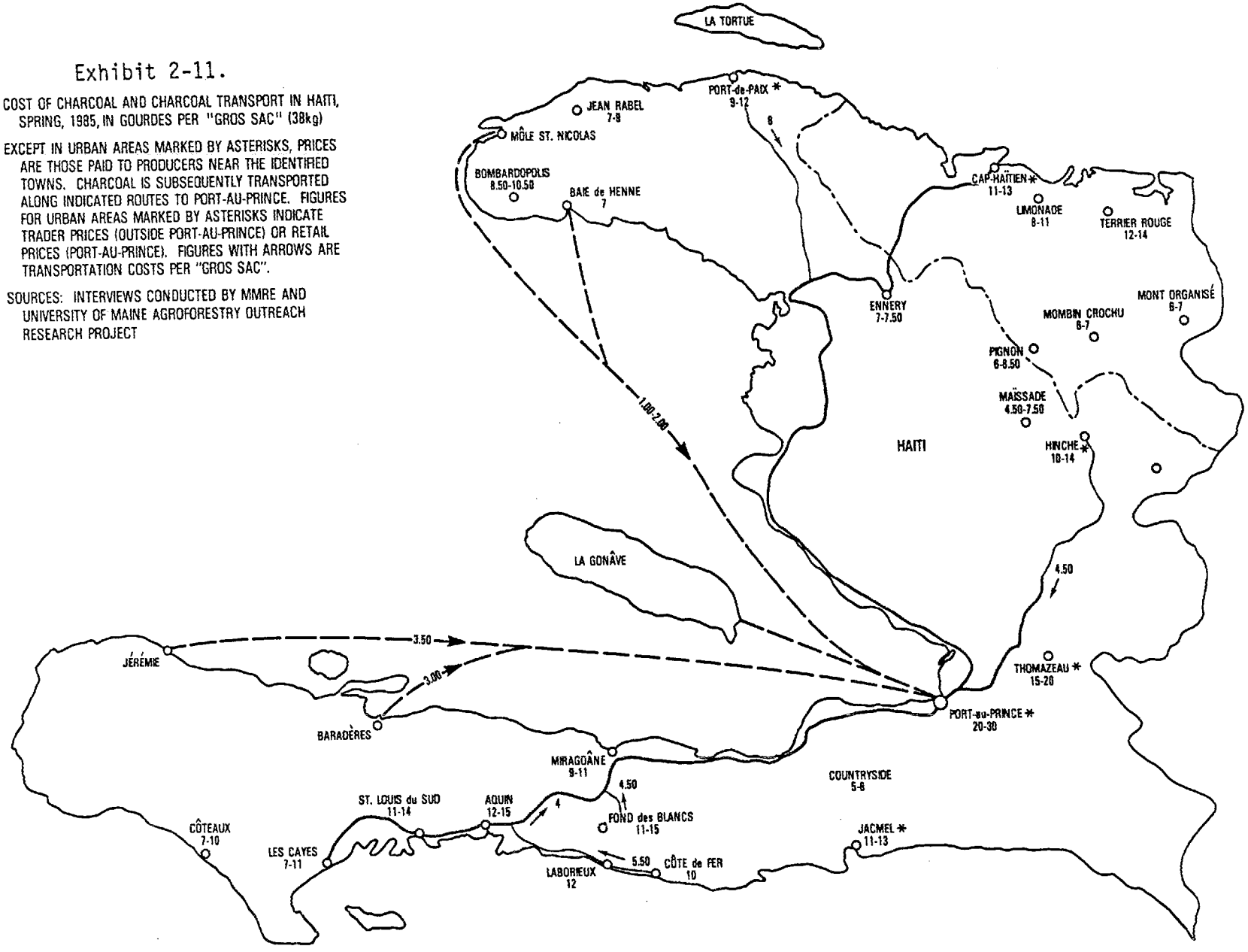

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Exhibit 2-12. **Selling Prices of Charcoal in Port-au-Prince, Spring, 1985, in Gourdes per "Gros Sac" (38 kg)**

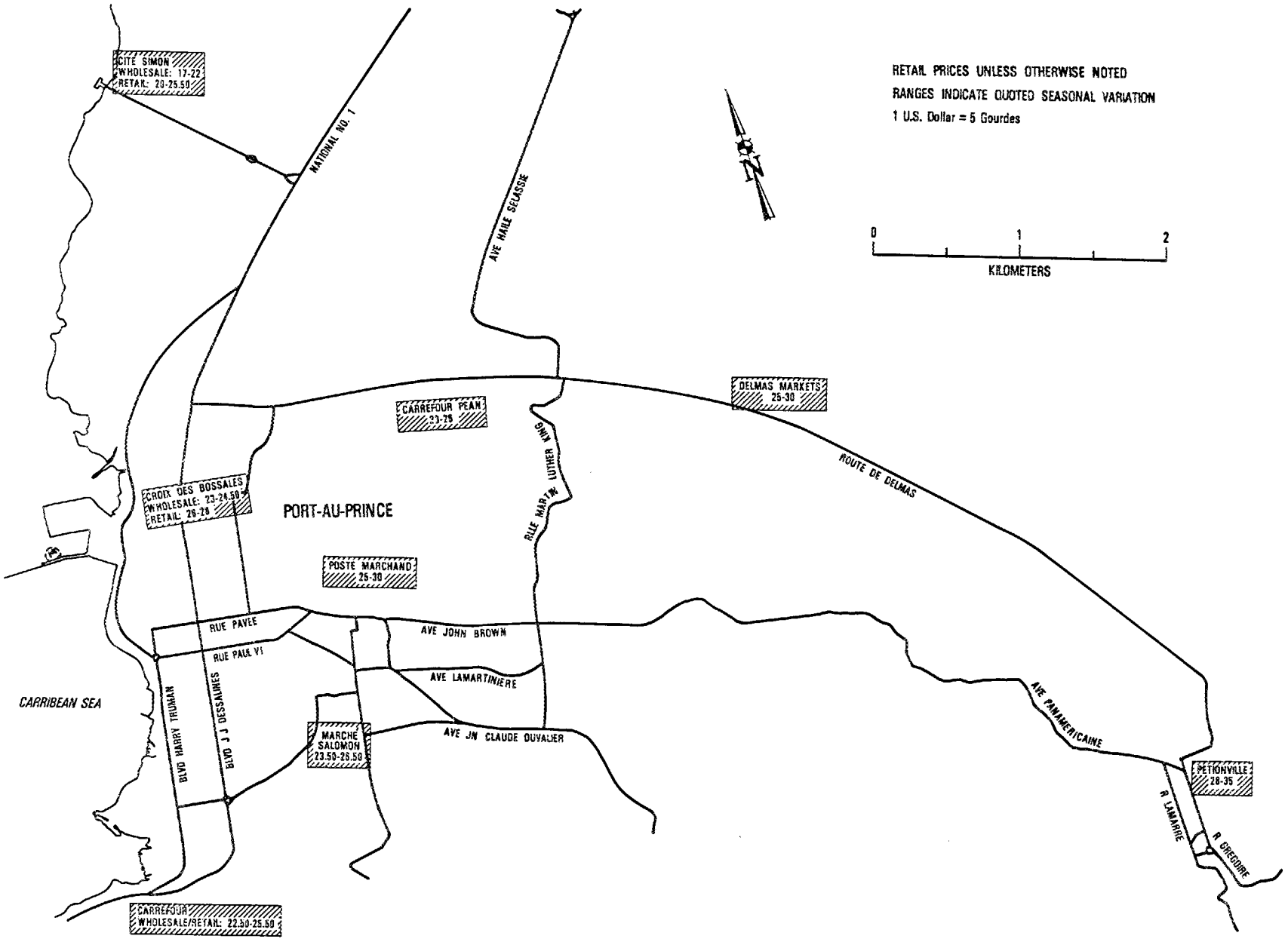

Exhibit 2-13. General Value Added Structure of the Charcoal Supply Chain in Gdes per Gros Sac.

Item	Cost	
Producer price 1/	5-10 gdes/sac	
Transport to Port-au-Prince	2- 6 gdes/sac	
Middleman margin 2/	2- 5 gdes/sac	
Wholesale buying price P-au-P (Subtotal) 3/		15-18 gdes/sac
Wholesaler margin in P-au-P	2- 5 gdes/sac	
Transport in P-au-P	1- 2 gdes/sac	
(Possible retailer margin	2- 5 gdes/sac)	
Retail selling price in P-au-P (Total) 3/		20-30 gdes/sac

1/Producer price generally reflects the value added by labor in charcoal making. Wood is usually gathered free, so no component of the producer price reflects a cost of wood. Consequently, the market price of wood diverges from the social value of wood.

2/A "forestry" and a "transportation" tax is imposed irregularly, which together would reduce this margin by Gde 0.25.

3/The ranges found on the subtotal and total do not represent a summation of all the component low figures and a summation of all the component high figures, because if one link in the chain is provided at a low cost, generally someone else in the chain takes a higher profit and evens things out.

Quantities

The quantities handled by a middleman can vary from a few sacks per week by some of the rural collectors who transport by donkey to hundreds of sacks per week by some Port-au-Prince wholesalers. Among Port-au-Prince wholesalers, we also found great variability, with volumes varying between 15 and 800 tonnes per year.

Seasonality

The charcoal wholesalers and retailers of Port-au-Prince indicated that seasonal variations occur in both price and volume. The high price season was said to be October through January. Interestingly, this was also quoted as the season of higher volume. Prices were said to vary 2 to 4 gourdes per sack between the high price season and the low price season (June through September). Volumes were said to increase about 22% above average during the busy season and to fall about 22% below average during the slow season.

It is difficult to explain price and volume increasing simultaneously. It may occur if demand is tremendously higher in the fall/winter season or if some wholesalers drop out of the market. However, consumers indicated that there is very little seasonality in their purchases, with them increasing only slightly around the Christmas season. We have no way of confirming whether some dealers drop out of the charcoal trade seasonally. Thus, the price and volume seasonality effects remain unclear.

Personal vs. Corporate Enterprises

Several questions were asked of wholesalers and retailers of charcoal to determine the degree to which the distribution chain would resist the introduction of a coal briquette. The first of these asked the person whether he/she was self-employed or worked for a firm. We found that almost all actors throughout the charcoal distribution chain operated as "personal businesses." We found no corporate entities involved in the distribution of charcoal. This higher degree of competition would tend to ease the introduction of a coal briquette, since no one agent could balk at accepting the briquettes and much affect their penetration.

Vertical Integration

The second question regarding resistance to coal briquette introduction involved the degree of vertical integration of firms. First, no wholesaler or retailer had family ties to their suppliers or customers. In Port-au-Prince, only one wholesaler of 12 answered that he bought from a person who was part of the same business. Outside Port-au-Prince, enterprises also are generally not vertically integrated. However, a certain percentage produce, transport, and sell their production. One of 12 answered this way outside Port-au-Prince, and a couple of people answering the transporter questionnaire also fit in this category. Overall, however, vertical integration is very low in the charcoal business.

Cash and Credit Policies

A third question exploring a possible limitation to the new product asked about financial ties between buyers and sellers. If credit is widely used, the link between the buyer and the seller may make the buyer less willing to accept a new product, if it jeopardizes the relationship with a supplier. Among wholesalers, we found that both cash and credit systems are used. In Port-au-Prince, 25% of wholesalers bought their charcoal with cash, 50% used credit, and 25% used both cash and credit. Outside Port-au-Prince, cash terms are much more prevalent, with 87.5% using cash to purchase their charcoal and the remaining 12.5% using either cash or credit. Among retailers in Port-au-Prince, however, credit is again widely prevalent. Fourteen of sixteen in the survey buy at least part of their charcoal on credit, and 50% always buy on credit. Thus, while there is no direct business or family link between Port-au-Prince wholesalers and their suppliers or between these wholesalers and retailers, there is a strong financial dependence created by selling on credit. In such a credit linked system, it would be important to get the wholesalers who offer the credit "on board" in preproduction marketing efforts for a coal briquette, so that retailers would be willing to offer the product.

Attitudes Towards a Coal Briquette

Wholesalers were virtually unanimous that they would sell a coal briquette if there were a market. As to the attitude of their clientele, both wholesalers and retailers were generally positive, but said it would depend on the quality of the briquette. Such things as length of burning time and calorific value were mentioned as necessary qualities. These reactions indicate that the only true test of consumer acceptance is to introduce briquettes into a test market.

2.2.4.3 The Wood Distribution System

Description

Wood plays a smaller role in the market for a coal briquette. Still, we briefly mention some of our conclusions regarding the wood distribution system.

Wholesalers in wood typically make the rounds with a truck and collect the wood from peasants who have gathered it or felled it. They may transport it themselves or through a hired transporter to Port-au-Prince. In Port-au-Prince they sell it to a second level of traders, here called retailers, or they may sell it directly to commercial establishments (see Exhibit 2-14).

Vertical Integration

Virtually all retailers and wholesalers of wood are independent proprietors. Yet some still work with other particular people to some degree; nine of twenty-eight answered that they purchased their wood from people who worked for "the same enterprise." Still, the predominance

lies with sole, independent proprietorships. Nobody bought from or sold to a member of his or her own family.

Cash and Credit Policies

Wood wholesalers in the countryside tend to pay cash. Retailers in Port-au-Prince often use credit with the wholesalers. Thus, wholesalers may serve an important banking/financing function in trade, and as in the charcoal supply chain, some special relationships based on credit arrangements may have built up between these two levels in the supply chain.

Wood Prices

Confirming the answers given to us by the commercial purchasers of wood, the retailers of wood in Port-au-Prince indicated that wood costs about $36.40 per tonne when bought by 100 piece lots (cf. $37.20 to 43.60 per tonne reported by the bakeries and dry cleaners). When bought by the truck load, prices were 33% less, again confirming reports from the commercial users.

Retail wood prices outside Port-au-Prince are about one-half the Port-au-Prince price. The one exception to this is the price in Cap-Haitien, which is comparable to the Port-au-Prince price.

We saw very little difference in prices of various wood species. However, there seems to be some disagreement about whether the price varies seasonally. Sixteen of twenty-eight wood wholesalers and retailers did not think that the wood price varies with the season, while the remaining twelve did. Due to the pattern of answers, the seasonal variation in wood prices may be isolated to certain areas in the country, such as the Central Plateau.

Attitudes Towards a Coal Briquette

Wood wholesalers and retailers gave similar reactions to those of the charcoal merchants about how their clients might react to a coal briquette. Generally, the reaction would be positive, they said, but the quality of the briquette would be important. Again, only a market test can bear this out.

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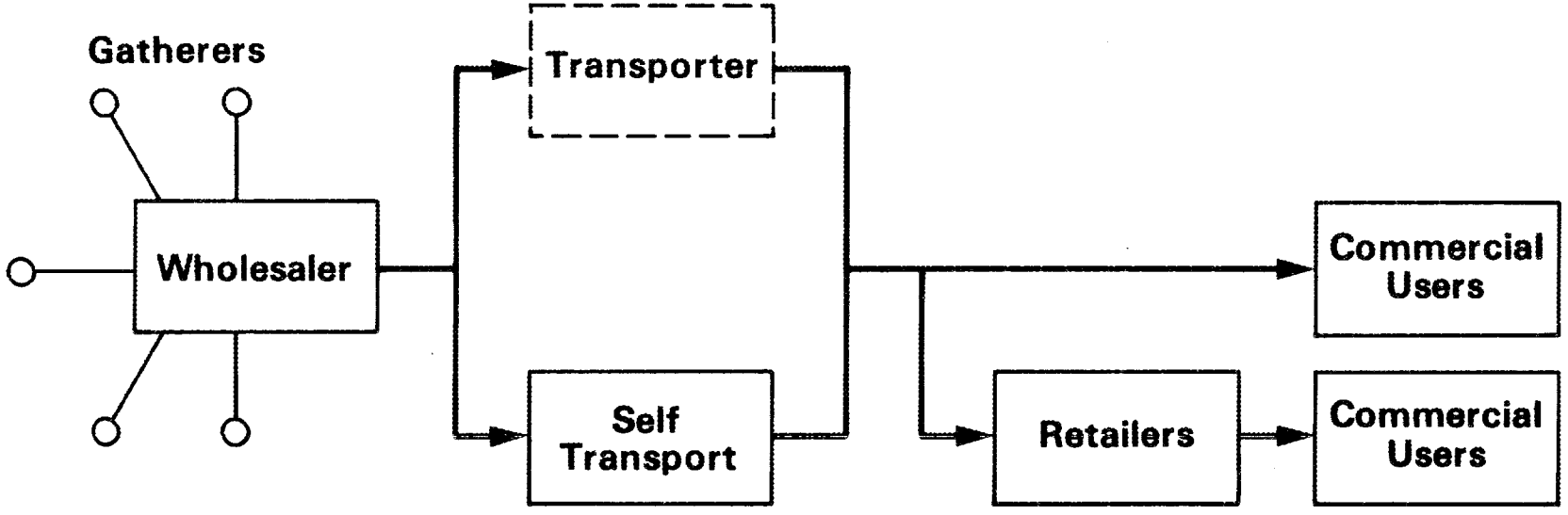
EXHIBIT 2-14. **The Haitian Wood Distribution System to Port-au-Prince**



3. FINANCIAL AND BUSINESS ASSESSMENT

To assess the business and commercial viability of a coal briquetting business in Haiti, the results of the market and technological assessments as well as discussions with the Haitian private sector were combined and evaluated. Specifically, this assessment was undertaken to:

- Define the most appropriate business approach based on the market and technological assessments and on discussions with the private sector regarding financing and investment;
- Evaluate whether such a venture is likely to be financially viable according to Haitian private sector business criteria; and
- Identify the steps that should be taken to proceed with such a private sector venture, if warranted.

This chapter documents the results of these investigations.

3.1 BUSINESS APPROACH

The market assessment and interviews with private sector business people who could be potential investors in a coal briquetting venture helped define the major elements of a business. These elements are outlined below.

3.1.1 The Coal Briquette Product

As a higher priced fuel than wood, charcoal is the primary target fuel to be displaced by a coal briquette. Present charcoal users stated that the coal briquette, to compete successfully, must perform at a level comparable to or better than charcoal. Therefore, it should meet the following product criteria:

- Ease of ignition - The coal briquette must be able to be ignited easily within a 3 to 10 minute period using similar cooking equipment to that currently used.
- Heat output - The amount of heat provided by the fire should be comparable to that provided by charcoal, to ensure that cooking practices do not have to be altered.
- Odor - The fuel must burn without a noxious odor. This requires that any sulfur content in the coal be neutralized.
- Health and safety - The fuel must perform at a level of health and safety comparable to or better than the existing fuels. This also requires sulfur suppression as well as control on particulates and attention to carbon monoxide.

- Strength and handling - The product must be able to be transported, packaged and stored in a manner similar to that currently used for charcoal. Thus, its physical strength must be adequate, and it must be able to withstand exposure to rain without degradation or be able to be packaged for protection.

The coal briquetting experiments done at the University of North Dakota indicated that such a product could be produced, using the additions of bagasse and sodium nitrate to improve the ignition and burning temperature of the coal. However, the coal briquette produced had a high ash content (nearly 40%) and thus a low calorific value per unit weight, only slightly more than half that of charcoal. This high ash level could jeopardize the product's acceptability to the customer due to the large amount of residual ash left after burning. (Charcoal has almost no ash.) However, no market feedback has yet been obtained on the implications of a high ash coal briquette, and it is part of our recommendations that any briquetting venture that can be shown to be economic be market tested before implementation. It is possible that the ash content may be acceptable if the price is lower than charcoal's. Also, the ash problem in the briquette would be reduced if it were manufactured from a coal with lower ash content, such as L'Azile may have.

3.1.2 Target Markets

A coal briquette could be acceptable technically as a substitute fuel for nearly all charcoal uses and for many firewood uses for cooking and commercial process heat. However, the target markets must be narrowed, based on the briquette's likely degree of price competitiveness. In Port-au-Prince, charcoal prices are usually at least 30% higher than in the countryside, where charcoal is produced locally. Charcoal prices approach the Port-au-Prince level only in a few other urban centers such as Cap-Haitien. Therefore, for the purposes of this assessment, the charcoal market in Port-au-Prince was established as the primary charcoal market. If a coal briquette can compete successfully in the Port-au-Prince charcoal market, there may be other charcoal markets that could ultimately be exploited, especially if the historical trend of rising charcoal prices continues. However, if it cannot compete against charcoal in Port-au-Prince, it is very unlikely that it will compete in any other part of Haiti.

With regard to firewood, prices of wood on a heat content basis are generally no more than half that for charcoal when they are purchased in bulk quantities (e.g., by truck load). Only when wood is sold in urban centers in small quantities (e.g., by 100 pieces or smaller units) do the prices approach that of charcoal. Thus, only segments of wood markets can be considered potential coal briquette target markets, and these markets are much smaller than the Port-au-Prince charcoal market. Consequently, the venture must be justified on the basis of Port-au-Prince charcoal use. If it can be, then the potential market might also be expanded by targeting those commercial wood users who buy in sufficiently small quantities to pay a relatively high price.

3.1.3 Marketing and Distribution

A well established trade for transporting, stocking, wholesaling, and retailing of charcoal and wood exists in Haiti. This transpires entirely in the private sector and consists primarily of individual entrepreneurs who have accumulated the expertise, financial capital, and equipment necessary to participate in the business. It is generally a very competitive industry, without apparent market domination by large enterprises. However, large wholesalers may exert some influence over the market due to their capital and ability to extend credit to charcoal producers, transporters, other wholesalers, and retailers. Cooperation of such wholesalers would likely be necessary when introducing coal briquettes to ensure that disruptive competitive reactions are not initiated.

It appears most appropriate to utilize this existing distribution structure in order to: (1) capitalize on the existing availability of equipment and distribution expertise, and (2) minimize the potential for a competitive reaction from existing charcoal suppliers, which could jeopardize the economics of the new venture. Almost universally, the existing participants in wholesaling, transport, and retailing of charcoal and wood expressed a willingness to handle coal briquettes. Consequently no difficulty is expected in developing these distribution capabilities.

It is expected that the product could be sold to the wholesalers either at the factory where it is produced, or at a wholesale depot near Port-au-Prince after bulk transport from the factory. At the point of sale, the wholesalers and/or retailers would have the responsibility to pack the briquettes in bags and do the final distribution and selling. This is current accepted practice in the charcoal trade.

3.1.4 Pricing

The charcoal markets in Port-au-Prince are quite competitive, with differences in price among different depots reflecting largely the transportation distances and middlemen costs involved. However, with the exception of one high quality charcoal (gayak), there are not significant distinctions in price based on charcoal quality. Rather, charcoal is priced largely on the basis of a certain price per gros sac. These gros sacs of charcoal vary widely in actual weight--ranging from 30 to 50 kg per sack. This does not seem to influence the price or disturb the people marketing or purchasing the product. Surveys by MMRE and the authors determined an average weight of a gros sac to be 38 kg, dry weight.

For the purposes of this analysis, we assume that a coal briquette could perform comparably to charcoal. If so, it could be sold at a comparable price per unit of calorific value as charcoal, which we also assume for the analysis. In reality, further market testing will be required to confirm pricing. A superior fuel might be salable at a

higher price, while an inferior product may require a discount in price.1/

Thus, it is assumed that the coal briquettes are sold into the distribution chain at the wholesaler level in Port-au-Prince at a price comparable (on a heat content basis) to the average wholesale buying price for charcoal. This wholesale buying price is 16 to 18 gourdes per gros sac, or $84-$95 per tonne (at 5 gourdes = $1). A price equivalent to 17 gourdes per gros sac has been assumed, equivalent to approximately $90/tonne.

No account has been taken of potential price increases in charcoal greater than the overall rate of inflation. If historical real price increases continue, this could provide additional pricing flexibility and/or potentially higher margins for the venture.

3.1.5 Manufacturing

Manufacturing is done most efficiently at the site of the coal supply in order to minimize the coal handling costs. Consequently, it is assumed that the briquetting plant will be located in Maissade for the Maissade coal, in L'Azile for the L'Azile coal, or near the Port-au-Prince port for imported coal. An appropriate site for a plant based on imported coal may be at or near the facilities of Ciment d'Haiti near Port-au-Prince, since coal is already received at their port terminal for cement manufacture.

With a target size of 105,000 to 125,000 tonnes of charcoal equivalent per year in Port-au-Prince, a reasonable plant size for analysis is 50,000 tonnes/year of briquette production. Because the briquette heat content does not equal the heat content of charcoal, this would not represent approximately one-half of the market. Rather, depending on the briquette heat content, it would be large enough to supply about a quarter to about 40% of the market (cf. Exhibit 2-7).

Building a smaller plant may be appropriate as a first step in a coal briquetting venture in order to minimize risks as well as to provide a tool for learning. However, a small plant would lack economies of scale and have a higher capital charge, and therefore the long term economics should be judged on a larger plant more appropriate to an established business. For this purpose a plant of 50,000 tonnes per year capacity is appropriate for analysis.

In designing the plant, attempts should be made to minimize capital cost and make maximum use of the low cost labor in Haiti.

1/Also, it is even possible that some consumer illusion may occur and that a product priced on the basis of weight rather than caloric content may prove viable. This possibility is limited by the fact that a Maissade briquette would have a high ash content, to which consumers would probably react negatively. However, only market testing can determine how these factors balance and what price would actually result.

3.1.6 Coal Supply

Private sector interest in coal briquetting will depend directly on the reliability and quality of the coal mined and supplied to the plant. Consequently, a private sector briquetting venture undoubtedly would depend on a private sector mining activity, since very little confidence would exist in a government mining operation.

Imported coal could provide a higher quality and possibly more reliable supply source, but it would be subject to the uncertainties of exchange rate fluctuations and the requirements for additional hard currency. Private sector investors expressed some hesitations about the imported coal option because of the difficulties of obtaining foreign exchange.

Assessment of the costs and method of mining coal in Haiti was not included in the scope of this study. However, other sources for mining costs exist. A German group, the Bundesanstalt für Geowissenschaften und Rohstoffe, estimated Maissade mining costs in 1982 (see Hugel, et al.). These costs, when inflated to 1985 dollars by a 5% per year cost escalation factor, range between $14 and $90 per tonne, depending on output (Kooi). At a coal output of 75,000 tonnes per year, which would be necessary to supply 50,000 tonnes of briquettes annually, mining costs would be about $38/tonne. The German study, however, has been criticized for using capital-intensive methods while labor is in surplus in Haiti.

A study by Scott Wilson Kirkpatrick & Partners estimated mining costs at Maissade using labor-intensive methods. After the initial mining year--in which nonrecurrent capital costs accrued--costs for 75,000 tonnes per year were estimated to be between $35 and $40 per tonne, depending on the overburden ratio encountered (i.e., whether 7.5:1 or 9:1).

While the German study overemphasized capital-intensive methods, the Scott Wilson Kirkpatrick study was at the other extreme in emphasizing labor-intensive methods. It utilized only pick, shovel and wheelbarrow methods for extraction and several trucks for hauling. A more optimal mix of capital and labor may exist, a case that Scott Wilson Kirkpatrick & Partners themselves note. In Pakistan, for instance, labor-intensive mining occurs at costs ranging from $10 to $40 per tonne, depending upon the difficulty of the seam. Given the uncertainties associated with the Haiti mining studies and the outside evidence on mining costs, we decided to use a coal cost at the low end of possible mining costs, in order to see if under such conditions, Haitian coal briquetting would be financially viable. The "base-case" cost that we chose was $15 per tonne. Sensitivity analyses were performed to examine the effects of alternative coal costs, and the results are also recorded in this chapter. For the imported coal options, hypothetical coal costs based upon the authors' knowledge of the international coal market were used.

3.1.7 Financing

If a coal briquetting venture is to proceed as a private sector initiative, financing for the briquetting plant will be required in three phases:

1. Early funding for feasibility testing and R&D;

2. Capital costs for the briquette manufacturing plant;

3. Working capital for the operation of the plant.

Each of these is discussed below.

3.1.7.1 Funding for Feasibility Testing and R&D

In Haiti's private sector, there is very little experience in capital intensive industries, and virtually no experience with coal briquetting. Some related activities such as mining, sand and gravel transport, and cement exist, but this experience is not widespread. It became clear in discussions with the private sector that the technology for such a capital intensive business would have to be well established and proven before Haitian business interests would become involved. This indicates that a pilot scale plant could be beneficial for purposes of demonstration and reduction of private risk perception.

Few resources exist in Haiti to undertake R&D or pilot scale demonstrations of unproven technologies. However, private businessmen have been increasingly undertaking cooperative research ventures with governmental donor agencies and private nonprofit organizations to expand the industrial capabilities within the country, especially in alternative agricultural and industrial products.

It is therefore expected that private sector financing of R&D and pilot scale manufacturing is not likely to be significant. However, if financing could be made available for the majority of R&D costs, the private sector would participate willingly (perhaps on a contract basis) to carry out the work with donor agencies such as USAID. While financial feasibility cannot be tested by pilot scale production--since lower production costs can be realized only by the economies of scale of a larger plant--technological feasibility could be proven in such a manner. When the technology of briquette manufacture is proven, it is very likely that private interests would be willing to participate in and finance the market testing and detailed production scale feasibility work.

3.1.7.2 Capital Costs for the Coal Briquetting Plant

The University of North Dakota evaluations indicated that a coal briquetting plant with a capacity of 50,000 tonnes per year of briquettes would cost between $3.6 million and $4.3 million, with lower costs possible if some surplus equipment available from retired briquetting plants in the U.S. were utilized. Thus, capital costs for a plant based on the University of North Dakota process were assumed to lie between $3.0 and $4.3 million.

Such a single venture is large by Haitian standards, and the financing of the venture would depend on completion of a very careful analysis to demonstrate technical and financial viability. However, numerous banking sources and potential investors confirmed that if the financial returns are attractive, a financing package could be arranged.

Debt financing is available through two groups of banking sources: (1) commercial banks, and (2) development banks. The commercial banks include large international banks such as Citicorp, Bank of Boston, the Royal Bank of Canada, and the Bank of Nova Scotia, as well several Haitian institutions, the Banque Nationale de Credit, the Banque Populaire Haitienne, the Banque de l'Union Haitienne, and the Banque Industrielle Commerciale. The development banks have been established by the Government of Haiti and international organizations in order to encourage investment in businesses that have the long term potential for improving Haiti's socioeconomic standards, employment, and hard currency earnings, but that might not otherwise be "bankable." Several of the important development banks are discussed more below.

In Haiti, a venture such as this would require an equity contribution from the investors of 30-50% of the total cost. Very rarely are ventures financed with less than 30% equity. The capital intensity and novelty of the process in Haiti makes an equity contribution of 40% of the capital cost reasonable. There is a small number of families in Haiti (perhaps 10-12) who have the resources to provide that equity individually. Alternatively, there are perhaps 40-50 families from whom could be drawn a small group of investors (perhaps 3-5) who could provide the equity collectively. Equity provided by a large number of investors through a syndicated share offering is almost never done in Haiti and is very unlikely to be a successful route to follow for a coal briquetting venture. The reason for this will become clear in a moment.

There is a strong interest among the development banks and donor agencies in Haiti in bringing a wider portion of the Haitian population into positions of equity ownership through share offerings. While it has been done in only a few cases in Haiti (most recently for a mortgage bank), wider share ownership of a project such as coal briquetting may be possible if donor backing and guarantee are included in the financing package.

In order to provide the debt financing, banks would seek mortgage liens on the plant equipment. However, since the value of that equipment under a liquidation situation is highly uncertain, it is probable that personal guarantees will be required from the investors. Indeed, this is the normal situation for private financing in Haiti: Personal guarantees from investors whom the banks know are necessary for debt financing. Consequently, bankers indicated that unless the loans are guaranteed by outside agencies such as World Bank or USAID, a single investor or small group of two or three investors willing to offer their personal guarantees would be required for debt financing. A larger syndicate likely would involve legal protections on personal assets, leaving the bank without sufficient guarantee.

Lending done purely on a commercial bank basis would require personal guarantees, as well as a sound feasibility assessment. While loans in Haiti typically carry very short terms of two to four years, terms of five to seven years probably would be obtainable due to the capital intensive nature of this project. Interest rates would be between 14 1/2 and 19% per year, which are the legally established lending rates. If this venture were found bankable at all, an interest rate of 15-16% probably could be obtained.

Initial principal repayment probably would be deferred until the plant was constructed and operating, and then the repayment schedule would be geared to match the cash flows of the business. Payment of dividends to the equity holders would be contingent on bank approval and could only be made when the agreed principal and interest repayment schedules have been met. For a commercial bank to be interested in these loans, the financial return on a cash flow basis needs to be sufficient for a three to five year repayment of the equity investment.

If the project can be shown to have strong socioeconomic benefits to Haiti, particularly employment creation and reduction of hard currency requirements, financing from various development banks would be possible. A number of development banks operate in Haiti or would extend operations to Haiti (Exhibit 3-1). Their objectives and financing terms differ, but all could be considered potential investors. In general, a development bank will only provide a portion of the debt financing, since they generally have maximum lending limits of about $500,000 to $750,000. However, they are likely to be able to provide guarantees on the debt, as well as potentially lower interest rates and longer payment terms than the commercial banks.

In summary, if a coal briquetting venture is pursued, the financial package probably will involve 40% equity and debt financing from both commercial and development banking sources. The interest rate on the loan probably would be 15% to 16%. If the financial returns are viewed as marginal, as opposed to clearly attractive, then donor agency financing or loan guarantees would be required.

3.1.7.3 Working Capital Requirements

Working capital (e.g., inventory and accounts receivable) for this venture is sizable, especially if the venture is based on imported coal. Banks are likely to require personal guarantees since liens on inventory or accounts receivable are not trusted in Haiti. This again indicates that the potential investors are likely to be those with substantial personal wealth.

Exhibit 3-1. Summary of Representative Development Bank Financing Available in Haiti

Source/ Organization	Purpose of Organization	Loan Terms: Maximum Loan Amount	Maximum Length	Interest Rate	Comment
Societe Financiere Haitienne de Developement, SA (SOFIHDES)	Term financing in industry and agro-industry	$150,000	7 yrs.	preferential rates (currently 14.5-16%)	Aimed primarily at industrial projects undertaken by entrepreneurs who lack established credit
Fonds de Developement Industriel (FDI)	Loan guarantees, discounts, and technical assistance for technical development	$500,000	15 yrs.	prevailing rate (discounted to banks) (currently 14.5-16.5%)	Encourages banks to make loans that would otherwise not qualify by guaranteeing 90% of loan and providing a fixed interest spread to the bank
Banque Nationale de Develoepement Agricole et Industriel (BNDAI)	Term financing for industrial and agricultural projects	$750,000	5 yrs.	preferential rates (currently 14%)	Haitian government development bank
Overseas Private Investment Corporation (OPIC)	Term financing, loan guarantees, and insurance for overseas investment	Up to 50% of project cost	12 yrs.	U.S. commercial rate	Financial services to U.S. investors or joint ventures in developing countries

3.2 ASSESSMENT OF FINANCIAL VIABILITY

We evaluated the financial attractiveness of a coal briquetting venture using the financial criteria employed by Haitian investors. Using these criteria, the following three options were analyzed:

1. Briquetting of Maissade lignite, including consideration of washing to reduce the ash content.

2. Briquetting of L'Azile lignite, considering both the good sample and bad sample characteristics.

3. Briquetting of imported coal, including consideration of cheaper, high volatile coals (such as from Columbia) or the briquetting of low volatile coals which would not require pyrolysis for smoke elimination.

3.2.1 Assumptions

For each of these options, we used the basic briquetting process developed by the University of North Dakota, and introduced variations to reflect the differences in coal qualities. For example, the good quality L'Azile coal and the imported coals would have low sulfur content and would therefore have a reduced need for lime for sulfur capture. Similarly, the low volatile coal under the import option would not require pyrolysis to eliminate smoke. We assumed that an added ingredient to ease ignition recommended by the University of North Dakota for the higher ash Haitian coals (e.g., sodium nitrate) would not be necessary for relatively low ash imported coals.

In developing the financial analysis, we made the following key assumptions:

- Selling price - The selling price for each type of briquette was assumed to be the Btu equivalent of the wholesale buying price for charcoal in Port-au-Prince. These representative selling prices are shown in Exhibit 3-2, which illustrates how the higher heat content in the briquettes made from the L'Azile good sample and imported coals allows a significantly higher assumed selling price than the briquettes from Maissade lignite. However, the ability to actually obtain such prices must be confirmed with market tests of actual briquettes.

- Briquette processing costs - The briquette processing costs were estimated from formulas developed at the University of North Dakota, with adjustments to reflect different coal qualities. The costs of the various constituents were based on quotations of costs from best sources in Haiti or on best judgements of delivered costs of materials to Haiti. Where certain processing costs were not estimated by the University of North Dakota (for example the labor and overhead costs) a best judgement was made based on Haitian wage and other cost conditions as well as briquetting experience in other countries. A summary of these assumed costs is shown in Exhibit 3-3.

- Transport costs - The cost of transporting the briquettes was based on actual charcoal transport costs determined in the market survey. The wide range of transport costs reflects the wide variation in actual observed costs. In the cases of L'Azile and imported coal, we expect that large transport volumes and moderate infrastructure improvements would result in transport costs nearer the low end of the assumed range. In the case of Maissade lignite, the transport costs will lie at the high end of the range unless major infrastructure improvements--mainly better roads--are made.

- Coal cost - As discussed above, a "base-case" of $15 per tonne was chosen to determine if Maissade and L'Azile coal briquettes would compete given rather low coal costs. This guards against wrongly eliminating these options, which might occur if the coal cost is overestimated. The sensitivity of the results to higher coal costs, however, was also examined. Based on our knowledge of the international coal market, we assumed imported coal costs of $40.00 per tonne for high volatile and $55.00 per tonne for low volatile coal. Sensitivity analyses were also performed for the imported coal options.

- Working capital requirements - We assumed that working capital equal to four months inventory of finished briquettes would be required on average, and that this would be financed by loans at 18% interest.

We assumed that the capital costs would be financed by 40% equity and 60% debt. A four-year payback was assumed as the required return on equity. We assumed a seven-year term for the debt, with interest at 15% per year.

Exhibit 3-4 shows the assumed capital costs for the various options. Plants required to process the lower quality, higher ash coals (e.g., Maissade lignite and the L'Azile poor samples) were assumed to have costs at the high end of the University of North Dakota range, whereas the higher quality coals were assumed to have capital costs at the lower end of the range. We assumed that the capital costs for a briquetting plant based on low volatile coals would be significantly lower because the pyrolysis step is not required. We also assessed the sensitivity of the results to changes in assumed costs because of the uncertainties involved.

To determine the quantity of coal required to produce each tonne of finished briquettes, we used University of North Dakota estimates of yields after pyrolysis and processing losses to estimate tonnes of coal needed to produce a tonne of char. We multiplied the results by the fraction of the briquette constituted by input char (or coal for the low volatile import case) to get tonnes of coal needed to produce a tonne of briquettes. Based on the University of North Dakota results, judgements for the yields and char fractions of the briquettes were made for the imported coal cases. Exhibit 3-5 shows the results.

Exhibit 3-2. Assumed Target Selling Prices for Coal Briquettes

Briquette Type	Assumed Heat Content of Briquette (BTU/#)	Assumed Charcoal Price ($/tonne)1/ @16 gdes/g.sac	@17 gdes/g.sac	@18 gdes/g.sac
Maissade	7,600	$50.80/tonne	$54.00/tonne	$57.20/tonne
L'Azile:				
Good sample	9,900	62.20	70.30	74.50
Poor sample	7,300	48.80	51.90	54.90
Imported Coal				
High volatile	11,600	77.60	82.40	87.20
Low volatile	11,215	75.00	79.70	84.30
For Reference:				
Charcoal	12,600	84.25	89.50	97.75

1/Wholesaler buying price for charcoal in Port-au-Prince.

Exhibit 3-3. Assumed Coal Briquette Manufacturing Operating Costs ($/Tonne of Briquettes)

	Briquettes made from:				
		L'Azile Lignite:		Imports:[a]	
	Maissade Lignite	Good Sample	Poor Sample	High Volatile	Low Volatile
Ingredients					
Bagasse	1.37	1.37	1.37	1.37	1.37
Lime	2.69	0.89	0.89	0.89	0.89
Molasses	5.38	5.38	5.38	5.38	5.38
Borax	0.47	0.47	0.47	0.47	0.47
Sodium Nitrate	3.90	1.96	3.90	--	--
Subtotal	13.82	10.07	12.02	8.11	8.11
Labor	6.00	6.00	6.00	6.00	6.00
Energy	--[b]	--[b]	--[b]	--[b]	2.00
Overhead & Other	3.00	3.00	3.00	3.00	3.00
Total Operating Costs (rounded):	22.80	19.10	21.00	17.10	18.10

[a]To ensure comparability between options and to simulate use of locally available bagasse, ingredients for the imported coal options are assumed similar to those of the domestic coal options. Further investigation may indicate more advantageous processes for imported coal.

[b]All processes utilizing a pyrolysis step are assumed energy self-sufficient by recycling and combusting the off-gases.

Exhibit 3-4. Assumed Plant Capital Costs
(50,000 Tonnes/Year of Briquettes)

Option	Range of Capital Cost (millions of 1985 US$)
Maissade lignite	3.8 - 4.3
L'Azile - good sample	3.0 - 3.5
L'Azile - poor sample	3.3 - 3.8
Imported - high volatile	3.0 - 3.5
Imported - low volatile	1.8 - 2.3

Exhibit 3-5. Input Coal Requirements

	Maissade	L'Azile Good Sample	L'Azile Poor Sample	Import High Vol.	Import Low Vol.
Tonnes input coal per tonne of char	2.50	1.92	2.27	1.39	1.05
Fraction of input char in briquette	.61	.67	.66	.77	.77
Ratio: Tonnes input coal/ tonne of briquettes	1.53	1.29	1.50	1.07	.81

3.2.2 Results

Using the costs and prices discussed above, we analyzed each of the options to determine whether the projected profit (measured in $/tonne of briquettes) appeared to meet the criterion typically used by Haitian private sector investors. The criterion used is a payback of the equity from the project's cash flow in four years, after paying all costs including debt retirement and interest. While these represent relatively stringent requirements, they nevertheless are typical of what is needed for a project with this perceived level of risk to be supported by the private sector.

The results indicate expected returns, given assumed 1985 costs and prices and that the plant operates at designed output rates. No account has been taken of the beneficial effects arising from increasing real charcoal prices (which could allow higher briquette prices) or from the additional cash flow when the debt is retired after seven years. On the other hand, the negative effects from possible delays in getting the plant operating at full output or from other effects such as the possible need to lower prices in the earlier years to "buy-into" the market. Thus, this approach represents estimates of future stable performance at capacity output; a more detailed analysis of the internal rate of return based on cash flows over the life of the project would be required as part of a full feasibility study. This approach allows a decision to be made about whether the remaining steps required to complete such a feasibility assessment (e.g., market testing, detailed plant engineering) and the attendant costs appear warranted.

The results of the analysis for Maissade and L'Azile coals are given in Exhibit 3-6. They show that briquettes made from Maissade lignite and the poorer L'Azile lignite samples would not produce a profit, but rather would return losses of about $20 to $30 per tonne of briquettes. This results primarily from the low quality of the coals which produce a briquette of relatively low calorific value and therefore a low assumed selling price per tonne. In addition, the costs are higher because of extra additives needed for ignition and the high coal input requirement resulting from poorer yields in pyrolysis. Even if the incoming coal were available at near zero costs, the briquette costs would likely exceed the current projected selling price.

However, briquettes manufactured from the good sample from L'Azile appear to be potentially financially viable. The range of estimated costs ($64.60 to $76.00/tonne) bracket the projected current selling price of $70.30/tonne, indicating that further examination of this option is warranted. The higher heat content, lower ash and sulfur levels, and greater yield through pyrolysis make this option potentially promising.

Exhibit 3-6. Financial Assessment of Coal Briquettes from Haitian Lignites ($/Tonne of Briquettes).

Costs	Maissade Lignite	L'Azile Coal Good Sample	L'Azile Coal Poor Sample
Input coal:	$15.00	$15.00	$15.00
(x ratio)	x 1.53	x 1.29	x 1.50
Cost/tonne briq.	$23.00	$19.40	$22.50
Briquette Manufacturing (from Exhibit 3-3)	$22.80	$19.10	$21.00
Transport to Port-au-Prince	$18.00-25.00	$15.00-25.00	$15.00-25.00
Financing:			
Debt retirement	$11.00-12.40	$ 8.60-10.00	$ 9.60-11.00
Working capital	2.80	2.50	2.60
TOTAL COSTS	$77.60-86.00	$64.60-76.00	$70.70-82.10
TARGET SELLING PRICE*	$54.00	$70.30	$51.90
Estimated Profit/(Loss)	($23.60 to 32.00)	($5.70) to 5.70	($18.80 to 30.20)

*From Exhibit 3-2. Target selling prices used here are equivalent to charcoal wholesale buying price of 17 gourdes/gros sac.

In Exhibit 3-7 the results of two options using imported coals are provided. Both options show a projected profit before return on equity within the range of estimates, indicating that the options utilizing imported coals do warrant further investigation.

Exhibit 3-8 compares the projected profit for all options with the level of return likely to be demanded by Haitian private sector investors. The three potentially viable options (L'Azile and two import approaches) are all of comparable viability given the uncertainties remaining at this time. While L'Azile has a slightly less attractive projected performance, it benefits from being an indigenous fuel with

greatly reduced foreign exchange requirements. Similarly, of the two import options, the slightly worse performance of the low volatile option must be weighed against the considerably lower capital costs likely, and therefore the lower required return in terms of $/tonne of briquettes. Moreover, the differences in projected performances are smaller than the range of error involved in these preliminary estimates. More study would be necessary to determine the best of these three potentially viable options.

Exhibit 3-7. Financial Assessment of Coal Briquettes from Imported Coals ($/Tonne of Briquettes).

Costs	High Volatile Imports	Low Volatile Imports
Input Coal 1/	$40.00	$55.00
(x ratio)	x 1.07	x .81
Cost/tonne briq.	$42.80	$44.60
Briquette Manufacturing (from Exhibit 3-3)	$17.10	$18.10
Transport to Port-au-Prince	$5.00- 8.00	$ 5.00- 8.00
Financing:		
Debt Retirement	$8.60-10.00	$5.20- 6.60
Working Capital	$4.30	$4.10
TOTAL COSTS	$77.80-82.20	$77.00-81.40
TARGET SELLING PRICE 2/	$82.40	$79.70
Estimated Profit/(Loss)	$0.20 to $4.60	($1.70) to $2.70

1/Imported coal prices are based upon authors' knowledge of international coal markets and do not represent specific quotations.
2/From Exhibit 3-2. Target selling prices used here are equivalent to charcoal wholesale buying price of 17 gourdes/gros sac.

Exhibit 3-8. Comparison of Coal Briquette Options

	Maissade Lignite	L'Azile Lignite Good Sample	L'Azile Lignite Poor Sample	Imported Coal High Volatile	Imported Coal Low Volatile
Required Profit*	$7.60-8.60	$6.00-7.00	$6.60-7.60	$6.00-7.00	$3.60-4.60
Estimated Profit @ Price Equivalent to 17 gourdes/gros sac charcoal	($23.60 to 32.00)	($5.70) to 5.70	($18.00 to 30.20)	$0.20 to 4.60	($1.70) to 2.70
Estimated Profit @ Price Equivalent to 18 gourdes/gros sac charcoal	($17.40 to 28.80)	($1.50) to 9.90	($15.80 to 27.20)	$5.00 to 9.00	$2.90 to 7.30

*Required profit calculated as a 4-year payback on the equity investment.

3.2.3 Sensitivity Analyses

Considerable uncertainty remains in the costs. Determining the sensitivity of the above results and conclusions to changes in the key assumption is warranted.

The most critical assumed costs are for the input coal and the briquette selling price. Exhibit 3-9 shows how the financial performance for the Maissade and L'Azile lignite options change for different coal input costs and assumed briquette selling prices. This shows that for the L'Azile good sample to meet the required return at current projected briquette selling prices (equivalent to 16-18 gourdes/gros sac of charcoal) would require coal to be available at $2 to $18/tonne. While the lower end of this range is impossible, the upper end is within the range of feasibility.

Alternatively, if input coal were assumed to cost $20/tonne, the briquettes would need to be sold at a price equivalent to 18.50-21.50 gourdes/gros sac of charcoal. The viability is thus quite sensitive to these variables.

For the Maissade lignite and the L'Azile poor sample, the sensitivity to input coal price is greater due to the low yield from the pyrolysis step. Further, briquette selling prices equivalent to about 26 gourdes/gros sac of charcoal are required before economic viability would be projected with coal prices of $7 to $16/tonne.

An assessment was also made of the improvement in performance which could be obtained from washing the Maissade and L'Azile (poor sample) coal to reduce the ash. This showed that the return could be improved by $6 to $15/tonne of briquettes by washing to a 10-15% ash level. However, this would not be sufficient to achieve economic viability at the present assumed charcoal selling prices, even if the washing were done at zero cost. Thus, it does not appear that washing of these coals would be sufficient to change the projected viability of briquette made from these coals.

For imported coals, the sensitivity to changes in assumed coal and briquette selling prices is shown in Exhibit 3-10. This shows that for the low volatile coal option, input coal prices of $40 to $58/tonne yield the required return for viability at the assumed present briquette selling prices. The high volatile case is more sensitive to coal price and requires a lower input coal cost due to the weight losses during pyrolysis. However, both options have portions of their ranges in the area of economic viability for likely coal costs, and they deserve more study. This is all the more the case because a real rise in charcoal price of only 5 to 10% to the 19-20 gdes/gros sac range makes these options highly likely to be viable, because of their extreme sensitivity to the charcoal price.

For all options, an increase in the capital cost of $500,000 results in an additional debt cost of $1.40/tonne per year. That increase also would require about $1.00/tonne additional return on equity. Lower capital costs would result in an equivalent savings in debt and equity costs.

3.2.4 Foreign Exchange Requirements

Because of the importance of foreign exchange requirements to any Haitian business venture, it is useful to assess the hard currency needs of the various briquetting options. For all options, the capital equipment must be imported, and therefore capital costs must be met almost entirely with hard currency. The borax and sodium nitrate for briquette manufacture also must be imported. Imported coal will require hard currency, and the low volatile import case will also require hard currency for energy to power the machinery.

EXHIBIT 3-9. ORNL-DWG 86C-8581

DOMESTIC LIGNITE PRICES
PROJECTED RANGES TO MEET REQUIRED RETURN

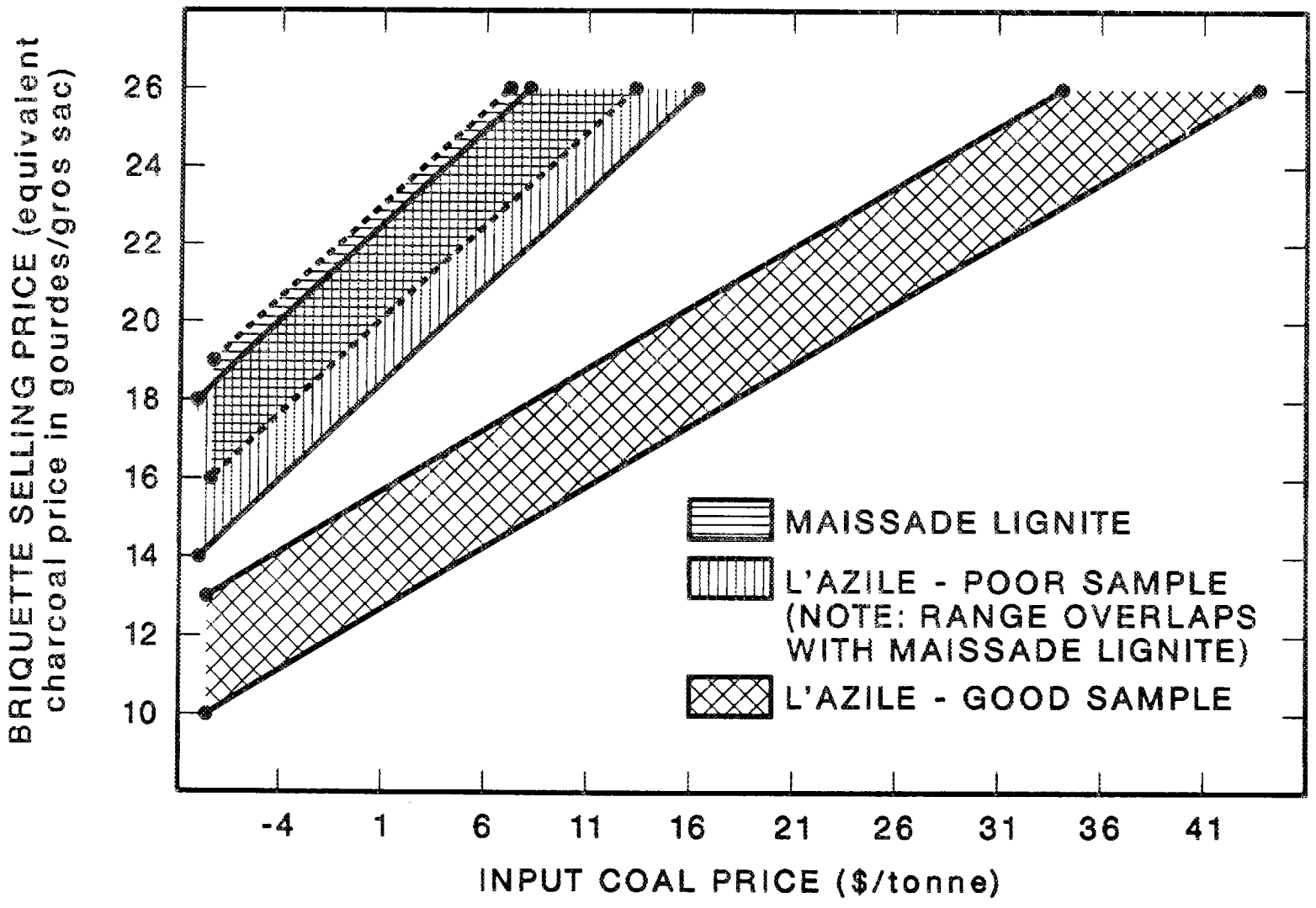


EXHIBIT 3-10. ORNL-DWG 86C-8582

IMPORTED COAL PRICES
PROJECTED RANGES TO MEET REQUIRED RETURN

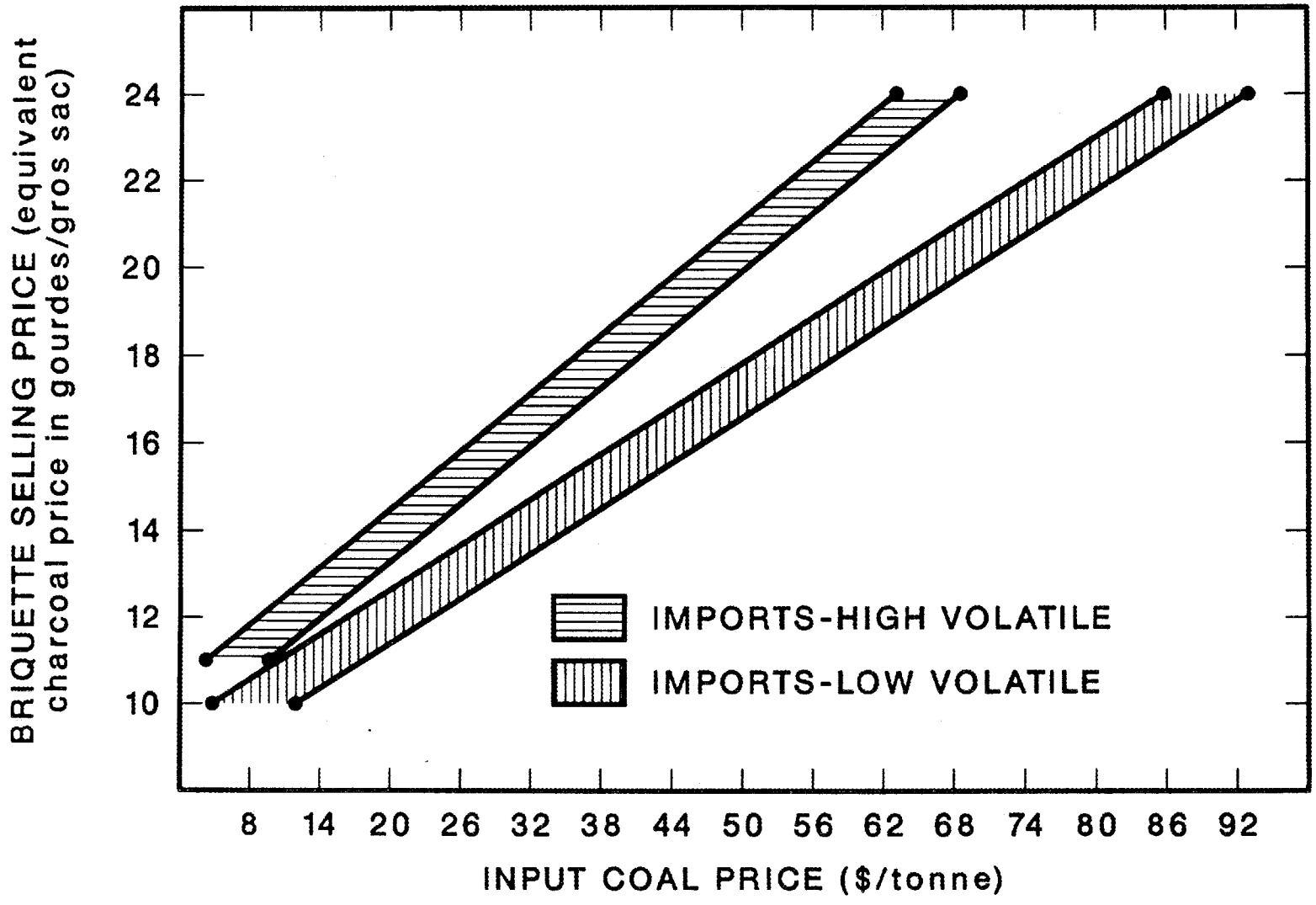


Exhibit 3-11 compares the hard currency requirements for the L'Azile good sample and low volatile import cases. Purely for illustrative purposes, assumed costs of input coal per tonne of briquettes from Exhibits 3-6 and 3-7 are used. An arbitrary assumption for the domestic L'Azile option is used that 50% of coal costs will be represented by foreign currency to capitalize the purchase and maintenance of mining equipment. The results indicate an annual hard currency requirement of $1,085,000 per year for L'Azile compared to $2,605,000 per year for imports. This dramatically illustrates the hard currency burden implied by import options.

3.2.5 Comparison with Kerosene

We compared price competitiveness of coal briquettes and kerosene, ignoring coal briquetting's advantages for in-country value added. To make this comparison, we used charcoal as a benchmark, since this is the product against which both new products would compete. Thus, our approach was to calculate the retail charcoal price at which kerosene would become economic, without accounting for the need to purchase a new kerosene stove. Our comparison took into account differences in combustion efficiencies between charcoal and kerosene. Assumptions for heat contents, combustion efficiencies, and retail prices for the price comparison between kerosene and charcoal are given in Appendix C.

The retail price of kerosene in Haiti prior to 1 November 1985 was $1.20 per gallon. On 1 November 1985, the price was raised to $1.85 per gallon through the addition of more taxes. Because the price rise resulted from a policy decision and not from market forces, we used the range of $1.20 to $1.85 per gallon for our comparison. The result was that charcoal would have to sell at retail between 26.50 to 40.75 gdes ($5.30 to $8.15) per gros sac for kerosene to be competitive. By comparison, charcoal currently sells in Port-au-Prince at 20 to 30 gdes per gros sac, depending on season and location in the city. Since some of the charcoal briquetting alternatives look economic at current wholesale (and hence retail) prices, or prices only slightly higher, they probably would compete successfully against kerosene.

The question has been posed whether a rise in the real price of charcoal would make Maissade lignite briquetting economic. It was stated that--at coal prices between $7 and $16 per tonne--wholesale charcoal prices would have to reach 26 gourdes per gros sac for Maissade lignite to be economic. If this equates to a retail selling price of 35 gdes per gros sac, then the equivalent kerosene cost would be about $1.60 per gallon. Kerosene would have to cost more than $1.60 per gallon for the Maissade lignite to compete.

Exhibit 3-11. Foreign Exchange Requirements
($/Tonne/Year)

Annual Operating Costs	Total Costs	Local Currency	Foreign Currency
		L'Azile - Good Sample	
Input Coal	$19.40	$ 9.70	$ 9.70
Briquette Ingredients1/	10.10	6.70	3.40
Other Briquette Costs1/	9.00	9.00	-
Debt Retirement 2/	8.60	-	8.60
Working Capital	2.50	2.50	-
Transport	15.00	15.00	-
TOTAL	$64.60	$42.90	$21.70
Annual Foreign Currency Required: $1,085,000			
		Imports - Low Volatile	
Input Coal	$44.60	$ -	$44.60
Briquette Ingredients1/	8.10	7.60	.50
Other Briquette Costs1/	10.00	8.00	2.00
Debt Retirement 3/	5.00	-	5.00
Working Capital	4.10	4.10	-
Transport	5.00	5.00	-
TOTAL	$76.80	$24.70	$52.10
Annual Foreign Currency Required: $2,605,000			

1/ From Exhibit 3-3 (rounded).
2/ Reflects low briquetting capital cost scenario of $3.0 million and 40% equity, 60% debt financing.
3/ Reflects low briquetting capital cost scenario of $1.8 million and 40% equity, 60% debt financing.

3.2.6 Comparison with U. S. "Charcoal" Briquettes

Placing foreign-made briquettes in Haiti does not appear to be a viable alternative. If the source of supply were the United States, the briquettes would not compete in the mass market. The Kingsford Company currently supplies their product, a briquette made partially from coal, to Haiti. It is targeted for the luxury market. Kingsford briquettes can only be purchased bagged, as the company does not ship any product in bulk. The product can be purchased wholesale by a Haitian buyer at $3.88 per 20-pound bag before freight charges. This is over $400 per metric ton, even without shipping. This would not compete with Haitian charcoal, which wholesales at under $100 per tonne and retails at approximately $100 to $150 per tonne.

3.3 CONCLUSION

A Haitian coal briquetting venture is possible, with the alternatives of L'Azile lignite or imported coal, either high volatile or low volatile being the prime candidates. Maissade lignite would not currently be economic, but rather would require a 45% to 60% increase in the real wholesale price of charcoal before it would become marginally viable.

The business arrangements necessary to implement a coal briquetting venture in Haiti have been described. The capital exists in country, with the main difficulty involving acquisition of foreign exchange. Entrepreneurs would be willing to undertake such a venture, if a thorough business feasibility study indicates that the venture can meet the investment standards demanded by the Haitian private sector.

4. INSTITUTIONAL AND GOVERNMENT POLICY ASSESSMENT

A set of institutional and government policy issues arises in evaluating the feasibility of marketing a coal briquette in Haiti. These issues concern the institutional setting and government policies that would affect coal mining; the manufacture, distribution, and marketing of the briquette; and the social impacts of these activities. Some of these issues, such as obtaining financial capital, credit availability, interest rates, and so forth, were discussed in Chapter 3. In this chapter, the following issues will be discussed:

1. Land and Mineral Rights Issues
2. Mining Regulations
3. Social Impacts
4. Infrastructure
5. Real Capital and Technical Talent
6. By-product Recovery
7. Tax and Subsidy Issues
8. Health, Safety, and Environmental Concerns
9. Government Institutions and Personnel

Major sections of this chapter are taken from the paper by Jean-Poix and Beauboeuf (see References).

4.1 LAND AND MINERAL RIGHTS ISSUES

While surface rights may fall into either private or government hands in Haiti, the government owns all mineral rights in the country. In the case of Maissade, the land above the deposit belongs largely to small peasant landowners, most of whom possess their title deeds. The government also owns approximately 2000 hectares of land in an area adjacent to the Maissade deposit that has not been fully explored for lignite deposits (Billiguy).

In the case of the land in private ownership, the government has the power of eminent domain for developing mineral resources. Under the amended Constitution of 1983, the government has the power of "expropriation for public purposes," with proper compensation to the

landowner (Article 35).1/ One of the public purposes specifically mentioned in legislation published in the Moniteur on 8 November 1979 is "the execution by the State of works for mines and pit exploitation granted to third parties or joint enterprises" (Article 10). Proper compensation is interpreted to mean fair market value. Such expropriations are directed by the Ministry of Public Works, Transport and Communications, and in the case of lignite mining would be carried out in concert with the Ministry of Mines and Energy Resources (MMRE).

In exercising eminent domain in the Maissade, the government would have to pay land prices between $285 and $575 per hectare. Land ownership patterns and prices were not investigated for L'Azile.

4.2 MINING REGULATIONS

Haiti encourages the private development of mineral resources under concessions, as exemplified in past concessions to Reynolds Aluminum for bauxite mining and to SEDREN for copper mining. Published mining regulations make clear the Haitian government's intent to encourage private sector mining. While the regulations allow the possibility of joint (government-private sector) mining ventures, the government has not involved itself in ventures in the past. The course for obtaining a concession is best delineated by repetition of selected mining statutes, published in the Moniteur on 8 March 1976:

Article 13

a) Only permits for prospecting, research, or exploitation constitute titles for the exploitation of mineral and energy resources.

Article 14

Nobody shall undertake any operation in [prospecting, research or exploitation of] mineral or energy resources without previously having obtained the title appropriate to the operation to be undertaken.

Article 17

a) Any request for the acquisition of a title must be made to the Ministry of Mines and Energy Resources, formerly the National Institute of Mineral Resources. It shall specify the geographic location in which the applicant wishes to operate and be accompanied by a map giving as much detail as possible about the planned works.

1/The Constitution of Haiti was suspended in February, 1986, after a change of the Head of State and the installation of an interim government. However, it is likely that provisions regarding eminent domain will be retained in any government reorganization.

b) The above request will be confidential. It does not confer any right with respect to the acquisition of a title. A nonrefundable fee of five hundred gourdes (Gdes 500.00) [equal to $100] will be paid by the applicant before the applicant's dossier will be considered.

c) With respect to the granting of a title, works undertaken by the applicant under permits previously held will be considered if appropriate.

By the Accord on the Exploitation of Natural Resources between the Republic of Haiti and the United Nations Revolving Fund for Natural Resources (part of UNDP) from October, 1982, the Haitian government grants exclusive exploitation rights during the period of the works to any mining company that has obtained a concession on a clearly delineated area.

Further, subject to security provisions, the Haitian government, which can be a shareholder if it desires, will put at the disposal of the enterprise in question for the purposes of the mining exploitation program, besides the services of its civil servants and employees, all reports, maps, aerial photographs, accounting documents and any other information considered necessary to realize the project. The Haitian government will also authorize representatives of the company to visit the project area.

Article 21 of the Statute already cited (Moniteur, 8 March 1976) outlines the provisions of the mining convention to be established between the Government of Haiti and the mining company:

a) Before a permit for research is granted, specific rules shall be established by a Mining Convention between the Government and the applicant.

b) This Convention may focus on the following particulars:

1) Obligations concerning acquisition and control of the capital of the enterprise for carrying out the works;

2) Obligations of the applicant to provide adequate infrastuctural works;

3) Obligations of the applicant to protect the environment and to carry out, if appropriate, [habitat] rehabilitation and economic amelioration in the area concerned.

4) Obligations of the applicant to train and employ Haitian personnel;

5) Obligations of the applicant to use Haitian supplies and production materials equal in price and quality to that normally sold on the Haitian market;

6) Obligations of the applicant to participate in the production phase, in the construction of the processing facility, refinery, conditioning plant, energy plant, or the supplying of such installations already established or to be created in Haiti;

7) Stipulations regarding financial, fiscal, or customs arrangements

8) An arbitration clause in case of conflict in the interpretation of the Convention;

c) The Mining Convention is concluded for the duration of the research permit and exploitation titles that may eventually result from it; however, some of the clauses may be stipulated for a limited period.

d) This Convention...may be adapted, modified and amended later, if necessary ....

In conclusion, the government regulations on mining appear quite conducive to private sector development of Haitian lignite deposits. However, we offer one caution from our discussions with private investors. While the Accord between the U.N. and the Haitian government stipulates that the Government may be a partner in mining operations, the private sector would trust the efficiency of the business only if it were purely private. Thus, to gain private sector confidence, we view a concession guaranteeing purely private control of mining as imperative.

4.3 SOCIAL IMPACTS

The social impacts of a briquetting operation fall into two main categories--those affecting populations in the area of the mine and plant and those affecting people currently engaged in wood and charcoal commerce.

Social impacts were studied for the current report only for a potential plant in the Maissade. Extrapolation to the situation at L'Azile can be done with caution. The Maissade, although rural, is not unpopulated. The land over the deposit is cultivated, mainly for subsistence agriculture. All families practice agriculture to some extent, and 70% pursue it full-time with no other recourse for employment. Approximately 185 households, almost 700 people, would be affected by expropriation of the land. While compensation for the land itself would be given, precedent indicates that no additional funds would be available for relocation assistance. Relocation is difficult in densely populated Haiti. These impacts, however, may be offset with the creation of new jobs in mining and briquette manufacture. With multiplier effects in support sectors, the displacement impacts in the Maissade of a Maissade plant would likely be offset by job creation.

A briquetting operation using imported coal would not require a mine in the Maissade, and hence the displacement of peasant farmers would not present a problem. This would be particularly true if the imported coal

briquetting operation were near the Ciment d'Haiti plant, which is in a nonagricultural area.

Were it not for the fact that trees are rapidly disappearing in Haiti, the major employment impact of a briquetting operation would be among workers in the competing fuel industry--charcoal producers and distributors. Ten years ago, Earl estimated that 4,370 people are engaged in the production of charcoal, and given the increased charcoal market size today the number is likely much higher. Any employment impact on charcoal producers carries special significance, because this job is employment of the last resort in Haiti (Conway). Any displacement means idling the poorest of the poor. Major charcoal production centers lie in parts of the country other than where jobs would be created by a briquetting facility, although L'Azile is better than Maissade in this regard.2/ If some of these people are put out of work while some of the beneficiaries of a briquetting venture are rich Haitian investors, an undesirable redistribution of income will have occurred. However, with the dwindling supply of trees in Haiti, charcoal production is likely to decline anyway, and current producers may find themselves out of work whether a coal briquetting plant is constructed or not. Nevertheless, assistance to charcoal producers would be appropriate if a briquetting plant is implemented in the near future, since the charcoal producers may be forced out of work sooner and more abruptly.

4.4 INFRASTRUCTURE

We will confine the discussion on infrastructure to roads for the two domestic lignite options and harbors for imported coal.

4.4.1 Maissade

The Maissade deposit is located in the Central Plateau, 11 kms northwest of the community of Maissade. Some important distances relative to the deposit are:

Deposit	- Maissade	11 kms
"	- Hinche	28 "
"	- Port-au-Prince	156 "
"	- Cap-Haitien	121 "

To reach the deposit from Port-au-Prince, one follows Highway 300 from the intersection of Highways 100 and 300 outside the city (see Exhibit 4-1). The highway is paved for 35 kms to Morne-Cabrit--two-thirds of the way to Mirebalais. After this, the route becomes gravel road of varying quality; long stretches are good and can be traveled at 65 to 75 km/hr (40 to 45 mph), while other stretches are very poor and must be negotiated with caution. The final stretch between Maissade and the deposit is backcountry, dirt road, involving several stream crossings. It is impassable by motor vehicle about 3 months of the year

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2/Most charcoal comes from the Northwest and Southwest Peninsulas; Maissade lies in the Central Plateau, while L'Azile lies on the Southwestern Peninsula.

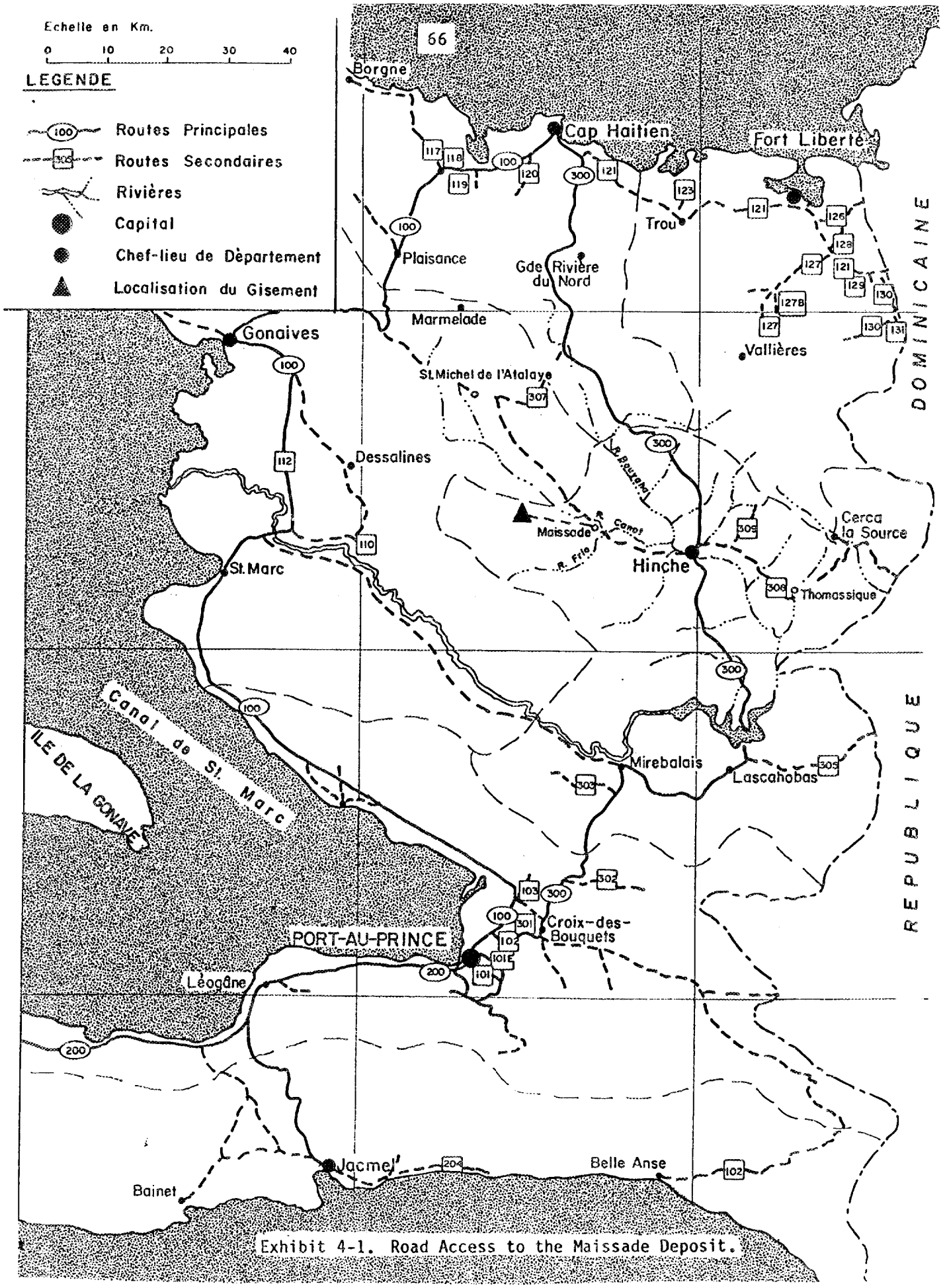

Exhibit 4-1. Road Access to the Maissade Deposit.

during the rainy seasons. Trucks require five to six hours to traverse the Maissade to Port-au-Prince route.

Cap-Haitien can be reached via hard-surfaced road, although stream crossings make the road impassable after rain. Transit time is four to five hours. Exhibit 4-1 shows a route to Gonaives via St. Michel de l'Attalaye, but this road is impassable to motor traffic.

The Department of Transportation in the Ministry of Public Works, Transportation and Communications has plans for road improvements in the Central Plateau region. These include upgrading the road between Pont-Sonde and Mirebalais to first class asphalt road and the construction of a secondary, gravel road from Hinche via Maissade to St. Michel de l'Attalaye. All road construction programs in Haiti are highly uncertain, despite plans. However, the construction of a mine at Maissade may well provide the impetus to follow through on the financing of road improvements. If plans are carried out, access to the Maissade deposit will become adequate, with the exception of the link between the community of Maissade and the deposit. This link will remain poor and indeed impassable during the rainy season. MMRE can, however, request that the Ministry of Public Works, Transportation and Communication improve access to the mine, which would require work on 5 to 6 kms of feeder road branching from the Hinche-St. Michel de l'Attalaye route at 6 kms beyond Maissade.

Costs of constructing new road in Haiti currently run approximately as follows:

- Secondary road (hard-packed gravel) $ 50,000/km
- Primary, provincial highway (asphalt) $250,000/km
- Primary, national highway (asphalt) $350,000/km

In conclusion, the transportation infrastructure for a Maissade lignite briquetting venture is weak. Plans to improve the road system exist, but their fruition remains uncertain.

4.4.2 L'Azile

The transportation network to the L'Azile deposit is much better. The deposit lies only about 20 kms from National Highway 2--good, primary asphalt highway running between Port-au-Prince and Les Cayes. To reach the deposit from Port-au-Prince, one travels over 134 kms of asphalt highway to Vieux Bourg d'Aquin, where a gravel road turns off towards the community of L'Azile. This stretch traverses 16 kms, and the deposit lies outside the town. The journey requires approximately 3 1/2 hours for trucks. Some upgrading of roads between the deposit and L'Azile or between L'Azile and National Highway 2 may be necessary for a briquetting operation, but no work of the magnitude needed in Maissade would be required.

4.4.3 Imported Coals

The major infrastuctural requirement for an imported coal operation is a port. The size of the port is the crucial variable, since the larger the vessels that can be received, the lower will be the transportation costs per tonne. For example, transportation for coal received from Colombia might cost $11/tonne for a 5,000 tonne but as little as $4/tonne for a 30,000 tonne vessel.

Several port facilities exist in Haiti for possible landing of imported coal. The first possibility is the harbor at Port-au-Prince. This port can currently receive vessels up to 20,000 tonnes. With minor improvements, the port would be able to handle 30,000 tonne vessels. The major drawback to the Port-au-Prince harbor is that a briquetting plant probably would not be constructed right in the city, near the harbor. Coal would have to be transferred to trucks for transportation beyond the city, raising transport costs.

A second possibility exists at the port where Ciment d'Haiti currently receives imported coal, several miles beyond the city. Coal handling facilities already exist there, and their cost and operation might be shared with the existing user. The drawback here is that the port currently can handle vessels of only 6,000 tonnes draft, although efforts are underway to dredge the harbor to increase capacity. Alternatively, it may be possible to bring 20,000 to 30,000 tonne vessels into the Port-au-Prince harbor, transfer to barges, and do final unloading in the Ciment d'Haiti port.

Finally, a port exists at Miragoane, 94 kilometers from Port-au-Prince. We were unable to learn the size of the port by the time of writing; however, it was from this port that Reynolds Aluminum once shipped bauxite. It may be possible to unload and briquette coal at Miragoane, and then ship the final product via truck to Port-au-Prince. The road between Miragoane and Port-au-Prince is National Highway 2, a high quality, asphalt road.

4.5 REAL CAPITAL AND TECHNICAL TALENT

Chapter 3 recounted details of financial capital availability and entrepreneurial talent. A word is given here to physical capital availability and technical talent.

Almost all physical capital would have to be imported. Only minor parts might be supplied locally to mining and/or carbonizing and briquetting operations. For instance, there is a boiler construction industry in Haiti.

Haiti also lacks private sector individuals with the necessary technical talent. Some nationals may have been involved in mining operations with Reynolds Aluminum prior to their 1982 closing or with the SEDREN copper mining venture, but a search for such individuals was not undertaken. It is likely that foreign mining expertise would be necessary. Coal carbonization and briquetting is a completely unknown technology in Haiti, so no technical expertise exists in the private

sector. Two government technicians with MMRE participated in the technological assessment for Maissade lignite briquetting at the University of North Dakota, so limited knowledge about the technology exists in-country.3/ However, foreign technical assistance would still be required to set up operations.

Given the need for technical assistance in both mining and coal briquetting technology, the possibility of joint ventures between Haitian investors and foreign companies is an attractive one. The Haitian private sector is quite receptive to this option, and indeed has a fair amount of international experience, if not as full partners, then at least as contractors to foreign firms and as importers and exporters.

4.6 BY-PRODUCT RECOVERY

Coal carbonization produces various by-products, primarily combustible off-gases and coal tar. These are mixtures of many materials, and it is possible to separate more refined chemical fractions from them. However, the likely technological approach in Haiti would be one of "intermediate technology," in which the off-gases and coal tar are left in their unrefined states. Nevertheless, these materials have economic value.

The University of North Dakota Energy Research Center assumed that a Maissade plant would be energy self-sufficient by using the off-gases for fuel. This assumption was carried into all briquetting options requiring carbonization in Chapter 3, and is an economic use of this by-product. If significantly more off-gases are available than can be utilized by the plant, extra electricity might be generated and supplied to Electricité d'Haiti for distribution. Neither Maissade nor L'Azile is currently electrified.

The coal tar by-product is a useful boiler fuel. It might be supplied to Ciment d'Haiti, Electricité d'Haiti, the essential oils plants, or the sugar mills or distilleries currently using fuel oil or Bunker C.

4.7 TAX AND SUBSIDY ISSUES

4.7.1 Tax Advantages

Because of limited resources in Haiti, the government encouraged development of manufacturing and assembly industries. This encouragement has taken the form of tax incentives to new industries, which mainly fall into customs privileges and income tax holidays. To gain these advantages, the investor must partly or wholly meet certain criteria. In practice, it is not difficult to meet these criteria. They include:

- Intensive and efficient use of available natural resources, including further processing of intermediate goods, recycling of processed materials, etc.;

3/These individuals were Betonus Pierre and Florelle Louis-Jacques.

- Increase the national income;
- The creation of new jobs and/or the further training of technical personnel;
- Increase the earning or reduce the outflow of foreign exchange;
- Strengthen the balance of payments position and/or reduce the dependency of the national economy on external factors;
- Introduce or disseminate new techniques or technology more appropriate to local conditions.

4.7.1.1 Customs Advantages

A firm approved under the privileged regime enjoys certain customs advantages. For a product targeted at the internal Haitian market as a coal briquette would be, exemption from customs duty can be approved either:

a) Totally and spread over the life of the firm: exempting imported materials, equipment, and inputs to production that have been authorized; consular tax, and storage and handling fees are not exempted;

or

b) For a period of ten years: exempting from two-thirds of import duties raw materials, semi-finished products, and wrapping and packaging materials when these articles are not available in Haiti at competitive prices or comparable quality.

4.7.1.2 Income Tax Advantages

Besides customs advantages granted to the firm under the privileged regime, certain income tax advantages accrue, depending on the location of the production facility:

a) In the metropolitan area of Port-au-Prince, an income tax exemption extends through the first five consecutive years from the date of initial production. After this period, the income tax begins taking effect in a graduated manner over the following five years as follows:

- 15% of income is taxable in the 6th year
- 30% " " " " " 7th "
- 45% " " " " " 8th "
- 60% " " " " " 9th "
- 80% " " " " " 10th "
- 100% " " " " " 11th "

b) Outside the metropolitan area of Port-au-Prince, an income tax exemption extends through the first fifteen consecutive years from the date of initial production. After this period, the income tax begins taking effect in a graduated manner over the following five years as follows:

- 15% of income is taxable in the 16th year
- 30% " " " " " " 17th "
- 45% " " " " " " 18th "
- 60% " " " " " " 19th "
- 80% " " " " " " 20th "
- 100% " " " " " " 21st "

4.7.2 Normal Tax Regimes

After expiration of the tax holiday, the firm legally falls under the regime of normal tax law. A briquetting plant would be subject to the normal corporate income (i.e., profits) tax, which is specified by Article 155 of the Decree of 28 September 1981 (Moniteur, 28 October 1981) as follows:

Gdes	0 to 10,000	($ 0 to $ 2,000)	- 10%
Gdes	10,000 to 30,000	($ 2,000 to $ 6,000)	- 20%
Gdes	30,000 to 60,000	($ 6,000 to $ 12,000)	- 30%
Gdes	60,000 to 100,000	($ 12,000 to $ 20,000)	- 35%
Gdes	100,000 to 300,000	($ 20,000 to $ 60,000)	- 40%
Gdes	300,000 to 500,000	($ 60,000 to $100,000)	- 45%
Gdes	500,000 and over	($100,000 and over)	- 50%

In addition to the corporate income tax, a mining company will be required to negotiate a contract with MMRE stipulating its taxation rates. Based upon contracts negotiated for the extraction of calcium carbonate, a good idea of the terms of such a contract can be gained. The company was required to remit to the State:

- a tax equivalent to 3% of the selling price of the product (calcium carbonate);
- a duty for the utilization of facilities and equipment, to be calculated at the rate of $0.50 per tonne of calcium carbonate sold...
- the corporate income tax already cited;
- a tax on dividends distributed to corporate shareholders, calculated at the rate of 15%.

Three things should be pointed out regarding the taxation of ventures involved in lignite mining and coal briquetting. First, the tax holidays are sufficiently long to allow investors to recoup their equity and repay most or all of their debt prior to initiation of taxation. Taxation only begins after the operation's cash flow is dedicated strictly to operating costs, maintenance, and profits. Secondly, the

taxes imposed on a mining firm, with the exception of the corporate income tax, are all negotiated with MMRE, an agency highly interested in promoting lignite mining in Haiti. If necessary, it is likely that advantageous tax regulations can be negotiated that would encourage the use of lignite in briquetting. Finally, in candor it must said that many firms have been able to find loopholes in the laws that enable them to renew their tax holidays when the holidays expire. Simple reorganizations of the firm have been one method. We are not advocating this, and indeed with the installation of a new government recently, it may no longer be possible to do this. But the fact remains that taxation has never been a hindrance to firms wishing to operate in Haiti.

4.7.3 Subsidization of Coal Briquettes

In order to make a coal briquette more attractive in the market place and/or to encourage its manufacture if it does not prove economically viable on its own, a subsidy might be considered. The subsidy might support the mining venture or the sale price of the briquette at the factory gate. The latter is probably preferable, because it is easier to remove when the price of competing products would allow it. An alternative to direct payment of the subsidy would be for the government to enter a purchase agreement with briquette producers and resell the briquettes at a low or negative margin. A subsidy may be warranted, since the main competing product, charcoal, sells at an artificially low price resulting from the lack of scarcity value imputed to the trees harvested for its production.

Nevertheless, subsidization of products is not normally pursued by the Haitian government. The fiscal position of the country really does not allow it, and besides, subsidization violates agreements between the Government and certain international sponsors. One source who wished to remain anonymous indicated that a firm addressing a problem of the highest order of importance, e.g., national survival, might receive consideration for subsidization. However, we doubt that a subsidy for a coal briquette would be forthcoming.

4.7.4 Taxation of Wood and Charcoal

There is no tax on wood cut for use as firewood. Taxation of charcoal is currently imposed at very low rates. The taxes include a Gde 0.10 ($0.02) forestry tax per bag (gros sac) for cutting the tree, and a Gde 0.15 ($0.03) transportation tax per bag. Thus, a $0.05 tax is put on a bag of charcoal that will eventually wholesale for $3.20 to $3.60 and retail for $4.00 to $6.00. Moreover, in many places there are no forestry agents and the taxes are not paid.

A strong case could be made for higher taxes on wood and charcoal, so that their use would reflect the increasing scarcity value of the trees harvested and their contribution to soil retention. The trees currently are imputed no scarcity value because (1) property rights are poorly defined for them, and (2) many trees are cleared merely to make room for additional agricultural cultivation. If a tax were put on charcoal to reflect the scarcity value of the trees, demand for the

product would be damped on the one hand, and a competing product such as a coal briquette would find it easier to compete.

In addition to the forestry and charcoal transportation taxes, some wholesalers and retailers of wood and charcoal reported paying a low market tax (taxe du marché). It generally ran 1 or 2 gdes per day, which became a small part of the cost of each sack sold. If a coal briquette is introduced, its sale could be encouraged by exempting it from the market tax.

4.8 HEALTH, SAFETY, AND ENVIRONMENTAL CONCERNS

4.8.1 Worker Health and Safety

Haiti is a signatory to the International Convention on Labor of 1935 (Revised). This Convention stipulates allowable duration of labor in coal mines and that operators of coal mines must take adequate protective measures according to accepted standards of international engineering to ensure worker safety, public health, and environmental quality.

4.8.2 Environmental Protection

Mine operators would be required to limit environmental damages, compensate losses, and execute land reclamation as stipulated in the Mining Convention negotiated with MMRE (see section on Mining Regulations). Article 25 of the Mining Regulations states:

> If the works are susceptible to harm public safety, springs and groundwater, to deteriorate the environment or cause serious pollution, the Ministry of Mines and Energy Resources (MMRE) will oblige the director of the works to take all necessary corrective measures according to international standards of engineering, in particular with respect to safety, worker hygiene, environmental protection, etc. Any delay in the application of these standards will be judged upon an individual basis.

Similarly, any enterprise involved in carbonization and briquetting would need to commit itself to stipulations regarding economic and environmental impacts, as negotiated with the Service de Geologie et des Mines of MMRE. Part of these stipulations would be the reparation of any ecological damage cause by the undertaking.

Laws and formalities aside, worker safety, environmental protection, and land reclamation in Haiti may depend simply upon the conscience of the firm involved. Enforcement from the government may be weak when it desires the services of the firm more than the fulfillment of the health, safety, and environmental regulations. A study of the cases with Reynolds and SEDREN, which could not be undertaken for this study, would be revealing. Of course, the advent of a new government, which may show significant interest in health and environmental concerns, may make the past an unreliable barometer.

4.9 GOVERNMENT INSTITUTIONS AND PERSONNEL

It has already been noted that Haitian technical capabilities in the areas of mining and carbonization/briquetting are limited. The Ministry of Mines and Energy Resources can assist any mining venture with geologists, but no further actual experience in mining engineering exists.4/ The two individuals who attended training at UNDERC in coal analysis, carbonization, and briquetting are also to be remembered. It must be emphasized, however, that any technical assistance provided by the Government of Haiti to a private sector venture must be requested voluntarily by the firm. The private sector currently is not interested in any venture that involves obligatory governmental participation.

Cooperation with the Ministry of Public Works, Transportation, and Communications (TPTC) would be required for any road improvements needed for mining and/or briquetting operations. This agency was cooperative during the lignite sampling process. It is likely, especially where the goals of the private firm involved in mine development or briquette factory construction coincide with those of TPTC, that a cooperative agreement could be reached.

With the stipulation already expressed about the venture being purely privately managed, other government agencies that may provide information or assistance include:

- The Office National de Technologie, which may provide technical personnel in initiating a coal briquetting venture;

- The Ministry of Agriculture, Natural Resources and Rural Development, which, in the event of domestic lignite mining, may assist in a plan to relocate displaced peasant farmers and an agricultural project to assist them.

4/MMRE does employ at least one mechanical engineer, who would be a likely candidate for foreign training in this field.

5. CONCLUSIONS AND RECOMMENDATIONS

The preceding chapters have described the results of the market, business and financial, and institutional and government policy assessments. Each chapter has provided conclusions. This chapter summarizes those conclusions and recommends further actions for USAID. The conclusions are summarized in terms of market potential, financial viability, business arrangements, and government policy issues. The recommended actions are divided into near term confirmatory investigations, and business implementation steps.

5.1 SUMMARY CONCLUSIONS

5.1.1 Market Potential

- A significant market potential exists for coal briquettes as a replacement for domestic fuels, especially charcoal.

- The primary market is a replacement for residential charcoal in Port-au-Prince. As the largest and highest priced charcoal market in Haiti, this market should be the primary target for coal briquettes. Approximately 95,000-110,000 tonnes of charcoal per year are used in the residential sector in Port-au-Prince, with an additional amount, (perhaps 5-10%) used by restaurants and small roadside cooked food vendors ("manger cuit"). Charcoal sells to the retail user at 21-28.50 gourdes per gros sac ($109-$150 per tonne), and sells to the wholesalers at 16-18 gourdes per gros sac ($84-$95 per tonne).

- Secondary markets could add to this primary market. These include: (1) charcoal in other urban centers such as Cap-Haitien, which eventually may have sufficiently high charcoal prices to allow successful competition, (2) wood in certain commercial and institutional markets, and (3) captive institutional markets such as school canteens. While half the wood used in the commercial sector is purchased in large trucks at prices approximately half the charcoal price, smaller commercial users purchase wood in small quantities (such as by the 100 pieces), and pay a price comparable to charcoal. The latter group could possibly develop into coal briquette customers. Institutional customers such as school canteens may be attractive because government policies could mandate the use of such an alternative fuel, providing a secure market. However, requiring such customers to use the briquettes at unsubsidized prices would require those in the countryside to pay more for their fuel than presently.

To penetrate these markets, coal based briquettes would need to be viewed by the market as comparable in quality, and equal or cheaper in price. Customers expressed willingness to try such an alternative product, particularly if it satisfied their criteria of easy ignition, satisfactory heating capability, reasonable price, and availability. The

research work at the University of North Dakota indicates that such a briquette can be manufactured. However, additional testing is necessary to confirm achievable prices and to evaluate actual consumer response, particularly to taste changes in food and ash residue if a product based on domestic lignite is contemplated.

5.1.2 Distribution System

The existing transportation and distribution systems for wood and charcoal in Haiti could be adapted to handle coal briquettes. This industry is made up largely of small private entrepreneurs who are not generally tied to the charcoal or wood producers. Consequently, these business people indicated that if handling coal briquettes is potentially profitable, they would be interested. We found that it would be important to gain the acceptance of Port-au-Prince wholesalers, since they often extend credit to individuals later in the distribution chain. The equipment required for transporting and distributing coal briquettes would be similar to that already existing, making new or additional equipment unnecessary. However, if the briquettes are not waterproof some additional protection will be necessary during transport and storage.

For distribution into the market, the coal-based briquette should be introduced at the wholesaler level, priced at a level comparable to the wholesaler's buying price for charcoal. The product could be sold to the wholesaler at the briquette factory, with the wholesaler arranging and paying transport to Port-au-Prince, or alternatively, the briquetting business could be responsible for transporting the briquettes in bulk quantities to a central depot near Port-au-Prince where they would be sold to wholesalers. This latter approach might allow more efficient transport to be undertaken.

A major drawback to the Maissade alternative is the poor road infrastructure between the coal deposit and the Port-au-Prince market. Much of the existing road is unpaved and in poor condition, and several stream crossings can be impassable in the rainy season. Thus, the Maissade deposit would be costly to exploit from a transportation standpoint. The L'Azile deposit, on the other hand, lies only 20 kilometers from National Highway 2, which is a good, paved highway all the way to Port-au-Prince.

5.1.3 Financial Viability

A preliminary assessment of the financial viability of a coal briquetting venture in Haiti has been made on the basis of:

- A market selling price calculated from present Port-au-Prince charcoal wholesale buying prices, transportation, and distribution costs;
- Costs for briquetting based on the process and costs developed by the University of North Dakota;

- Assumed coal costs based on mining costs experienced in other developing countries and imported coal markets.

- A comparison with kerosene based upon a kerosene price prior to 1 November 1985 and a price after this date that included additional taxes.

Three business options were evaluated:

- Manufacture of briquettes from the Maissade lignite deposit at a plant located in Maissade;

- Briquettes made from the L'Azile coal deposit in a plant located in L'Azile;

- Briquettes manufactured from imported coal at a briquetting plant near Port-au-Prince.

The conclusions from this evaluation are:

- Maissade coal briquettes - Briquettes manufactured using the University of North Dakota briquetting process and without washing of the coal would not be financially viable at current charcoal prices. This results because the high ash, sulfur and moisture in the coal result in a relatively expensive briquetting process, a briquette with low calorific value, and, thus, low potential selling price. Sensitivity analyses indicate that it is unlikely that coal washing would alter this conclusion. However, only thorough technical experimentation with washing can prove whether this is economically unfeasible.

  While currently uneconomic without coal washing, briquettes from Maissade lignite would become competitive as the real price of charcoal rises. Wholesale charcoal buying prices would have to rise to approximately 26 gourdes per gros sac (1985 gourdes) for this to occur. At this point, the briquettes would also be competitive with kerosene at retail prices of $1.60 per gallon or more.

- L'Azile coal briquettes - Briquettes manufactured from coal exhibiting qualities similar to the best L'Azile sample are likely to be financially viable, meeting the investment return criteria required of the private sector. However, the lower quality L'Azile samples would give a result comparable to the Maissade lignite. Consequently, additional geological work is required to establish the true quality and extent of the L'Azile deposit.

- Briquettes from imported coal - The financial return appears comparable to that from the good quality L'Azile lignite, but the business would have considerable foreign exchange requirements. Additional evaluation is required to establish which is the preferred combination of coal type and briquetting process if imported coal is to be pursued.

- o Comparison with kerosene - Charcoal would have to sell at retail prices between 26.50 and 40 gdes ($5.30 to $8.00) per gros sac for kerosene to be competitive. This does not include a premium for purchase of new kerosene stoves. The upper end of this range corresponds to the new tax-included price of kerosene. In comparison, the current Port-au-Prince retail charcoal price is 20 to 30 gdes per sack. Therefore, at current charcoal prices, certain coal briquetting options mentioned above are financially viable while kerosene is not.

5.1.4 Business Arrangements

There is a strong interest in the Haitian private sector to manufacture a coal briquette as an alternative to charcoal, especially if domestically available Haitian coal can be utilized. Furthermore, sufficient financial capital exists among private sector investors to sponsor a project of the magnitude of a coal briquetting venture. (Banks have been known to turn away deposit accounts because there is more cash available than "bankable" projects for lending.) However, the investment must satisfy their conservative financial return criteria, which typically require a payback on the equity investment within a three to five year period.

The charcoal market in Port-au-Prince is viewed as a growing market with increasing prices due to fuelwood scarcity. No reversal in this trend is envisioned until wood scarcity pushes prices to a level that makes kerosene or bottled natural gas competitive. The opportunity to replace charcoal with another Haitian produced fuel, rather than imported petroleum products, is very attractive to Haitian businessmen.

In addition, there is an increasing interest on the part of wealthy Haitian businessmen to undertake business ventures that have a visible positive impact on employment, reduction of foreign exchange requirements, and an improvement in the overall economic condition of the poorer Haitian people. In this regard, briquetting based on Haitian coal would be very attractive, whereas a venture based on imported coal would be considerably less interesting. Also, the foreign currency requirements and the exposure to foreign exchange fluctuations on the price of imported coal probably would make the typical investor more wary of a venture based on imported coal.

Potential investors expressed a willingness to consider a wide range of alternative business arrangements if the basic venture appears attractive. However, the following points are important:

- o Involvement of the government of Haiti is not viewed positively, and most private businessmen would not be interested in participating if the government were involved in the venture.

- o The involvement of USAID in some form, such as in the preparation of the feasibility study, is viewed positively, providing greater credibility to the venture and improving the basis for seeking attractive development bank financing.

- o Joint ventures with foreign partners who bring the manufacturing expertise are viewed positively by potential investors. Investors expressed considerable flexibility about how such joint venture arrangements could be put together.

In summary, if a financially attractive business venture is defined, and sufficient technical and marketing research completed to confirm its viability, considerable private sector interest and participation can be expected.

5.1.5 Government Policy and Institutional Issues

Chapter 4 indicated that the Haitian government regulations and institutions are conducive to private sector development of coal briquetting, from mining through manufacturing, distribution, and sales. In mining and minerals-based industries, the Government of Haiti (GOH) has tended toward concessionary agreements leaving complete control to private interests with only potential stipulations on employment of local labor, environmental, health and safety restrictions, etc. The GOH tends not to engage in joint ventures.

In addition, the GOH usually does not subsidize commercial ventures. This suits the private sector, since little private sector support is likely if the viability of the venture depends on government supports, subsidies, or import barriers. Similarly, confidence must be given that government policies that could affect the venture's viability in the future, such as the pricing and availability of kerosene, should remain consistent and not be allowed to undercut the briquetting venture.

The government's approval for tax holidays and other commercial incentives will be beneficial to gain private support. Fortunately, Haiti provides liberal incentives in this direction, with full and partial tax holidays extending 10 years in the Port-au-Prince area and up to 20 years for ventures outside Port-au-Prince. Customs exemptions probably would be available also, which would be important for the capital equipment and some variable inputs necessary for coal briquetting.

An increased tax on charcoal was one method discussed to encourage the use of a coal briquette. Such a tax could be justified fully, because the scarcity value of the trees from which the charcoal is made is not currently included in the price of charcoal. The equitable enforcement of such a tax would be the major problem in trying to implement it.

The social impacts of the project must be approached with caution, and ameliorative actions may need to be taken. Charcoal producers may be displaced by a coal briquetting venture, and these people can be among the poorest of the poor in Haiti. Some job creation in mining and/or in briquetting may offset this. However, charcoal producers will probably lose their jobs as trees disappear, so briquetting's displacement of them my be illusory.

5.2 RECOMMENDED ACTIONS

Supplying a coal-based fuel as a replacement for charcoal appears to be a potentially viable business venture which will further USAID's policy objectives in Haiti, including:

- Reducing the extent of deforestation by substituting coal fuels for currently used wood-based fuels.

- Improving the country's balance of payments by using either a domestically available coal such as L'Azile lignite or imported coal to provide an alternative fuel in Haiti, which is not kerosene or another petroleum product and which has greater domestic value-added.

Consequently, USAID should sponsor the next steps in the feasibility assessment work with an increasing involvement of the Haitian private sector. Specifically, the following actions are recommended in three steps:

- Near Term Confirmatory Assessments

- Detailed Market Testing and Technical Evaluations

- Support in Initiating a Business Plan

Each of these is discussed below.

5.2.1 Near Term Confirmatory Assessments

The following actions can be initiated over the next few months to provide data required to support expenditures for detailed market testing and plant design studies:

- L'Azile Geological Testing - The L'Azile coal deposit has not yet been characterized with the use of geological drilling; current knowledge is based only on a few samples taken from outcrops. The Government of Haiti's Ministry of Mines and Energy Resources has prepared a proposal to geologically assess the L'Azile deposit, although funds have not yet been secured. USAID should consider assisting in the support of this geological work aimed at characterizing the quality, reserve level, and appropriate mining costs.

  In conjunction, USAID should consider sponsoring over the next three to six months preliminary coal testing, washing, and briquetting tests with the L'Azile lignite to confirm that the coal quality and resulting briquettes are adequate to justify detailed market testing and plant engineering. The University of North Dakota investigations focused on the Maissade deposit and included only limited tests using the L'Azile coal.

- o Evaluation of Imported Coal Alternatives - A wide range of types of imported coals are available to Haiti at varying prices, each having a different optimum coal briquetting process to produce a satisfactory fuel. USAID should conduct a study to assess the most attractive options for a coal briquette venture in Haiti using imported coal. At the same time, an evaluation of the price competitiveness of such briquettes as exports to other Caribbean countries should be conducted. This could provide the means for balancing the requirements for hard currency through export sales.

- o Maissade Coal Washing. If additional financial resources are available, USAID should consider employing a coal washing expert to establish for certain whether or not washing of the Maissade lignite to reduce the ash level significantly (to 10-20%) is technically and economically feasible.

5.2.2 Detailed Market Testing and Technical Evaluations

If the steps above continue to demonstrate an attractive business venture, the following steps should be undertaken to demonstrate market and technical feasibility. This work would provide the basis for a "bankable" feasibility document that would attract private sector equity and support requests for debt financing from the banking community. The recommended steps are:

- o Form Private Sector Planning Group - To obtain input from the private sector, an ad hoc group should be formed of potential participants in manufacturing and distribution of briquettes. This group could assist in planning and participate in the remaining activities described below. Potential members of this group can be identified through the Office of Private Enterprise Development, USAID/Haiti, or the authors of this report.

- o Conduct Detailed Market Test in Haiti - A detailed market test should be conducted to explore market related issues. A reasonably large quantity (e.g., 20 tonnes) of briquettes should be manufactured from Haitian coal or equivalent, using the briquetting process likely to be employed in Haiti. The briquettes could be manufactured abroad or, if sufficient resources are available, a small scale plant could be set up in Haiti. The market tests should be conducted in Port-au-Prince over a several month period, with the following purposes:

  - To confirm consumer acceptance of such factors as ease of ignition, burning and cooking performance (e.g., temperature, duration), odor, cleanliness, ash content, strength, etc.

  - To establish fuel use efficiency, that is, establish in actual cooking situations how many kilograms of briquettes are required to perform the same amount of work as a kilogram of charcoal.

- To confirm the likely coal briquette pricing level as a result of information obtained above. Determine pricing strategies, such as the need to introduce the briquette at lower prices initially to gain rapid market penetration.

- To confirm methods of packaging, storing and transporting briquettes, and determine approaches for marketing and distribution.

o Conduct Detailed Technical Assessments. The University of North Dakota technical investigations have established basic technical feasibility at a laboratory scale, but further technical examinations are necessary to support the equity investments and debt financing. These technical investigations would be aimed at:

  - Confirming the briquette formula, giving special attention to minimizing the costs of producing an acceptable briquette. The investigations should examine whether lower proportions or lower grades of the expensive ingredients (e.g., sodium nitrate, borax, molasses, lime) could be used, and whether the proportion of cheap, locally available materials (e.g., bagasse) could be increased.

  - Designing a production plant appropriate for the first installation in Haiti, minimizing capital costs through use of labor-intensive processes and possible use of surplus equipment from the United States.

  - Determining the capital costs for the plant, and the annual operating costs of ingredients, labor, energy, overhead, and any other inputs.

  Such an assessment, built on the laboratory work of the University of North Dakota, would be carried out most effectively by a firm experienced in briquetting, which would be capable of becoming a supplier of the equipment and/or a joint venture partner in the operation of the plant.

o Complete "Bankable" Feasibility Assessment. Working with prospective private sector participants, the results of the test market and detailed technical assessments above should be incorporated into a document sufficient to obtain financial support from the banking community. Thus, it will encompass the business plan to initiate the venture, including the resulting detailed financial projections of cash flows over time, calculated return on investment, and payback.

5.2.3 Support in Initiating a Business Plan

Depending on the outcome of the detailed assessments above, it may be appropriate for USAID to be involved in some way in the initial steps of the business plan. Such involvement could take many forms, and should be considered if it appears necessary to attract private equity and bank financing for the project. Roles which USAID could consider at that point include:

- Technical assistance in the construction and commissioning of the plant.

- Financial assistance for an initial small scale plant. It may make sense to start a briquetting venture with a small plant in the Port-au-Prince area using imported coals, even if the long term plan calls for Haitian coals. This allows the briquetting effort to continue in parallel with mine development. Such a small plant conceivably could be relocated later to the proximity of the mining site. A small plant may not have a sufficiently rapid payback to be financed privately, in which case financial assistance from USAID may be appropriate.

- Assistance in achieving initial market penetration by making the commitment to purchase specified quantities of briquettes for use in such captive markets as school canteens. Such purchase commitments, phased out over two to three years, could improve the attractiveness of the venture to Haitian investors by reducing the market risks.

In summary, coal briquetting in Haiti can have a future. Further investigative work along the lines outlined above, however, is necessary to determine the best route to take.

APPENDIX A

COMMERCIAL SECTOR AND DISTRIBUTION SYSTEM SAMPLES

A.1 THE COMMERCIAL SECTOR

Exhibit A-1. Numbers of Firms Surveyed in the Commercial Sector.

	Bakeries	Dry Cleaners	Restaurants	Street Vendors
Short Form	29	16	27	9
Long Form	11	14	5	5
TOTAL	40	30	32	14
Total No. in P-au-P from tax lists	146	94	144	-

Exhibit A-2. Numbers of Firms Surveyed in the Commercial Sector by Other Investigations.

	School Canteens*	Essential Oils	Distilleries
Sample Size	95	29	53
Total No. in Country	1942	--	461

*School canteen survey work was incomplete at the time of writing. Estimates in this report are based upon the available data.

Sources:

School canteens: Surveys by the Ministere des Mines et des Ressources Energetiques, Republique d'Haiti
Essential oils: La Roche and Kooi
Distilleries: Barkley Byess

A.2 THE DISTRIBUTION SYSTEM

Exhibit A-3. Sample Sizes for Charcoal Suppliers

Supplier	Inside Port-au-Prince	Outside Port-au-Prince	Totals
Transporters	8	16	24
Wholesalers	12	12	24
Retailers	17	5	22

Exhibit A-4. Sample Sizes for Wood Suppliers

Supplier	Inside Port-au-Prince	Outside Port-au-Prince	Totals
Transporters	1	11	12
Wholesalers	8	8	16
Retailers	3	9	12

APPENDIX B

ADDITIONAL RESULTS

Exhibit B-1. Family Sizes and Charcoal Use Rates by Income Class from Port-au-Prince Household Survey.

Income Class	Persons per Household	Charcoal Use (Kg/Household/Week)
Poor	7.22	21.56
Medium	6.00	25.98
Rich	5.76	28.31

Exhibit B-2. Sensitivity Analysis for Charcoal Consumption by Street Food Vendors in Port-au-Prince.

If Number of Food Vendors Is:	Then Projected Annual Charcoal Use Would Be:
100	535 tonnes/year
200	1,070 "
500	2,675 "
1,000	5,350 "
2,000	10,700 "

Based on an average use rate of 2.7 gros sac per week or 5.35 tonnes per year.

Exhibit B-3. Retail Charcoal Prices in Port-au-Prince in Gourdes by Unit of Purchase.

Market	Price in Gourdes per Unit of Purchase		
	Pile** (1 kg)	Small Sack**	Large Sack**
Outside P-au-P*		11.71	22.81
Cité Simon (Wharf)			20.75
Carrefour			22.88
Croix des Bossales/ La Saline			23.88
Marché Salomon			24.03
Poste Marchand			27.00
Delmas Markets	1.11		27.40
Other P-au-P Markets		18.88	26.08
Petionville			28.50

*Prices for purchases by Port-au-Prince consumers when they are in the provinces and they bring the charcoal back to Port-au-Prince

**Piles = approximately 0.45 kg ($0.10 pile) or 0.90 kg ($0.20 pile)
Small sack = 23 kg
Large sack = 38 kg

Exhibit B-4. Types of Stoves Used by Income Category
(Percentage of Families Using Each Type)*

Type of Stove	Poor	Medium	Rich
Natural gas stove	1.4%	15.7%	55.6%
Electric stove	2.8%	3.9%	5.6%
Circular charcoal stove	57.7%	17.6%	0.0%
Square charcoal stove	33.8%	23.5%	16.7%
Multiple-hearth stove in an iron frame	9.9%	25.5%	22.2%
Multiple-hearth stove in a masonry frame	14.1%	33.3%	55.6%

*Percentages do not add to 100% because some families use more than one stove type.

APPENDIX C

CONVERSION FACTORS FOR HAITI LIGNITE BRIQUETTING PROJECT

C.1 CHARCOAL

Weights - Based on survey work performed by MMRE and the authors and drying tests performed by Clarence Kooi, USAID Resident Energy Advisor:

1 large sack (gros sac) = 38.0 kg dry weight

1 small sack
(petit sac or ti sac) = 23.0 kg " "

$0.20 pile (1 gde pile) = 0.90 kg " "

$0.10 pile (0.50 gde pile) = 0.45 kg " "

Heat content = 12,600 BTU/lb
= 7,000 kcal/kg
= 0.7 tonne of oil equivalent/tonne charcoal

Combustion efficiency in traditional Haitian circular stove: 22%

Retail charcoal prices:

Low: 20 gdes/gros sac
High: 30 gdes/gros sac

C.2 WOOD

364 kg/m3 (Measurement by MMRE staff)

Heat content = 6300 BTU/lb
(30% moisture) = 3500 kcal/kg

1 large truck = 17.3m3
(gros camion) = 2000 pieces of wood
= 6.3 tonnes of wood

100 pieces of wood = 0.33 tonnes of wood

1 tonne of wood = 3.5 x 106 kilocalories
= 0.5 tonnes of charcoal

C.3 KEROSENE

Heat contents = 31,600 kcal/gallon

Combustion efficiency in wick stove: 42%

Retail prices:

Low: $1.20/gallon (price prior to 1 Nov. 1985)
High: $1.85/gallon (price after 1 Nov. 1985 with additional tax)

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