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INTERIM MARKET REPORT ON LDC ALTERNATIVE ENERGY WORK

by

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October 24, 1980

SUMMARY

A rapidly expanding market for resource assessment, planning, policy analysis, applied R&D and demonstration can be seen for energy development as an element in developmental assistance to less developed countries (LDCs).

Sponsorship includes the U.S. government, including both the Department of Energy and 1831 sponsors such as U.S. Agency for International Development (AID). Rapidly expanding involvement in energy development by multilateral organizations such as the World Bank and the United Nations Development Program creates a new need on the part of these sponsors, and opens what has formerly been a closed club to new prospects of penetration by Battelle.

Substantial investments in institution-building are also an important new market, paralleling past Battelle accomplishments such as the Korea Institute of Science and Technology (KIST) project, but specifically tied to energy planning and development needs.

Battelle's preeminence in energy technology, particularly in positions of special strength from the DOE domestic program, creates a favorable opportunity for translating 1830 capabilities into 1831 business for new sponsors.

We have assembled capabilities and inventories of key staff for comprehensive energy resource assessment and planning studies for DOE, and look toward additional markets for similar studies funded by the United Nations Development Program, the World Bank and AID.

Opportunities for applied R&D and demonstration are proliferating with creation of new, interagency programs for hardware development through DOE/AID/DOC, as well as through multilateral sponsors. For the main part, these can be developed as 1831 business.

Significant possibilities of a new, 1830 initiative lie in international cooperative research and assistance programs within the International Energy Agency (primarily in consort with OECD countries) and through bilateral energy agreements with an increasing number of developing countries. Participation in whole country resource assessment and planning studies, either in a lead role or in support of Argonne-lead projects is under discussion, although the FY 81 budget for this may be prohibitively tight. Participation in the DOE-executed bilateral energy programs is likely to evolve following established lead roles under the domestic program, with some supplementation from experiences gained through work for utilities and industry.

The total market size available as a target is difficult to assess, but is estimated to be at least $300 million. The degree of capture possible is limited more by our other commitments, space and available manpower than by the market size. Combining capabilities and key staff from a number of Battelle components constitutes our current tactical approach, giving a pool of about 220 known staff, with about 20% having relevant foreign experience.

The shape of a mature business mix will be evolved over the next year in cooperation with key staff and management.

INTRODUCTION

The format of this report is the same as the initial market survey prepared in August, 1979. It is divided into the following major sections:

- Broad Considerations & Trends
- Sponsoring Organizations
- Types of Projects Being Funded
- Potential Roles for Battelle
- Recommendations for Market Development

Each of these categories covers an expanded amount of detail, obtained from expanding contacts and an improving resource center of collected documents. There is some unavoidable redundancy between categories, since both organizations and content are involved in all.

In addition to a table of contents to help the reader, a glossary of this new alphabet soup is appended. Resource documents and contacts are listed in the appendix as well.

BROAD CONSIDERATIONS AND TRENDS

1. U.S. International energy policy, as articulated in July, 1980 by the Department of State, includes the following elements:
   - Increased national and international efforts to accelerate the development of conventional and non-conventional supplies of energy at relatively stable and predictable prices
   - Promotion of conservation and more efficient use of energy
   - Enhanced international cooperation in energy R&D
   - Assistance to developing countries to overcome energy-related constraints to their development
2. Substantial international agreement that accelerated energy development assistance is needed for LDCs has been reached by the OECD and in UN Conferences; e.g., in Bonn in 1978 and in the Tokyo round of Multilateral Trade Negotiations in August, 1979, as well as at the UN Conference on Science and Technology for Development held in Vienna in August, 1979. The latter meeting has been followed by establishment of an interim Fund for Science and Technology administered by the United Nations Development Program. A special fund for energy exploration and pre-investment surveys has just been established within the UN for low income LDCs (June, 1980).
3. U.S.legislation to permit international assistance on development of alternative energy is embedded in the Energy Reorganization Act of 1974, International Development and Food Assistance Act of 1977, Solar Photovoltaic Energy Research, Development and Demonstration Act of 1978, Nuclear Non-Proliferation Act of 1978, and the Department of Energy Authorization Act of 1978.
4. Increasing U.S. attention to LDC alternative energy development is reflected in increasing funds for such projects in foreign assistance appropriations requested from Congress: FY 79 - $2.6 billion, FY 80 - $3.2 billion, FY 81 - $3.4 billion. These figures include contributions to multilateral agencies such as the World Bank and UN, among others. AID's R&D budget on new and renewable energy has built from $3.5 million in FY 79 to $19.9 in FY 81 (468% increase). DOE R&D related to LDC energy is estimated at $25 million in FY 80.
5. Efforts by DOE, AID, USDA, Commerce and Treasury are increasingly coordinated through a new federal entity, the International Development Cooperation Agency, which replaces the Department of State as the umbrella agency for all developmental assistance. The new agency Director reports to the President, and the new agency contains AID. The Director of IDCA is Chairman of an interagency Development Coordination Committee, with representation from DOE, State, USDA, Commerce and Treasury.
6. Relationships between AID and DOE have been stressed, but are gradually improving under pressure of the Office of Management and Budget. Existing memoranda of understanding between the two agencies are likely to be worked to provide more assistance from DOE to AID. Expanded involvement by DOE in international R&D has been treated in some detail in position papers prepared by the Department of State in mid-1980.

7. A substantially increased UN program in energy development, including R&D and institution-building is quartered within the United Nations Development Program (UNDP), whose budget is approaching $1 billion. In addition to its normal budget and activities, UNDP administers the work of other UN entitites such as the United Nations Industrial Development Organization (UNIDO) and is responsible for a new Special Fund for Science and Technology which heavily emphasizes energy R&D. Centralization of all developmental assistance through the UNDP results in part from U.S. pressure, since operation of the UNDP is with voluntary contributions rather than use of the UN general fund. Increased attention by the U.S. Department of Commerce is being given to building U.S. income from goods and services bought by UNDP.

8. The International Bank for Reconstruction and Development (World Bank) is sharply increasing their energy program, with a target of $25 billion over the next five years. The same trend can be seen with other multilateral regional banks, such as the African Development Bank, the Asian Development Bank, Carribean Development Bank, etc. Programs include feasibility demonstrations of small scale (about $4 million maximum), currently running about 15 per year. In addition, special loans for institution-building, training, resource assessment and planning are awarded, and most Bank projects include elements of technical and consultant services. Although the Bank has been something of a closed club, especially where dispersal of about $250 million in project planning and feasibility study funds are concerned, the rapidly expanding effort in the energy sector may open some membership opportunities for Battelle.

9. Increasing coordination of UNDP, World Bank and AID activities is leading to complementary projects, and in some instances to jointly funded projects. Penetration of one of these agencies, through a sort of 'old boy' network, leads into the others with comparatively little effort. In the case of countries wherein we have bilateral energy agreements, the network includes DOE and the Solar Energy Research Institute.

10. Bilateral energy agreements are building slowly, and have so far been handled through DOE's Office of Scientific and International Programs in Conservation and Solar Division. Execution has been by the Solar Energy Research Institute (SERI) International Division. As these agreements proliferate, SERI's capabilities become strained. It may be reasonable to expect some division of execution responsibility among other national labs, including PNL, basically following lead assignments in the domestic program (e.g., biomass, energy storage, some elements of the wind program, etc.).

11. Substantial delays in startup of major applied R&D programs and in institution-building have been caused by Congressional resistance to a new entity within the the International Development Cooperation Agency - the Institute for Scientific and Technical Cooperation. This was part of the President's Reorganization Plan for international development assistance (partially implemented by creation of IDCA). The ISTC was to be the home of R&D, technology transfer and institution-building within IDCA, a separate entity on a peer level with AID. AID is an action-oriented agency, and R&D and other

longer term payoff missions often get short shrift when competing needs for commodities and service projects are given priority. With respect to energy-related R&D, institution-building and cooperative projects with host country technologists, it is now unclear whether the mission will shift to AID (at least temporarily) or to DOE. A new, $10.5 million interagency program for applied R&D on new energy hardware is being established with AID, DOE and DOC participation. This partially addresses the immediate problem of the hold on creation of the ISTC.

12. Underlying driving forces supporting a sustained LDC assistence program include some basic and important interests of the U.S. Our trade income from LDCs now exceeds the combined total of trade with Europe and Japan. The rate of economic growth in these countries is higher than that of the OECD nations, including the U.S., and expansion of these economies (and markets) is seen as an important factor in revitalizing our own economy and dealing with trade imbalances. The trade situation is summarized in the table below.

U.S. TRADE TRENDS WITH DEVELOPING COUNTRIES

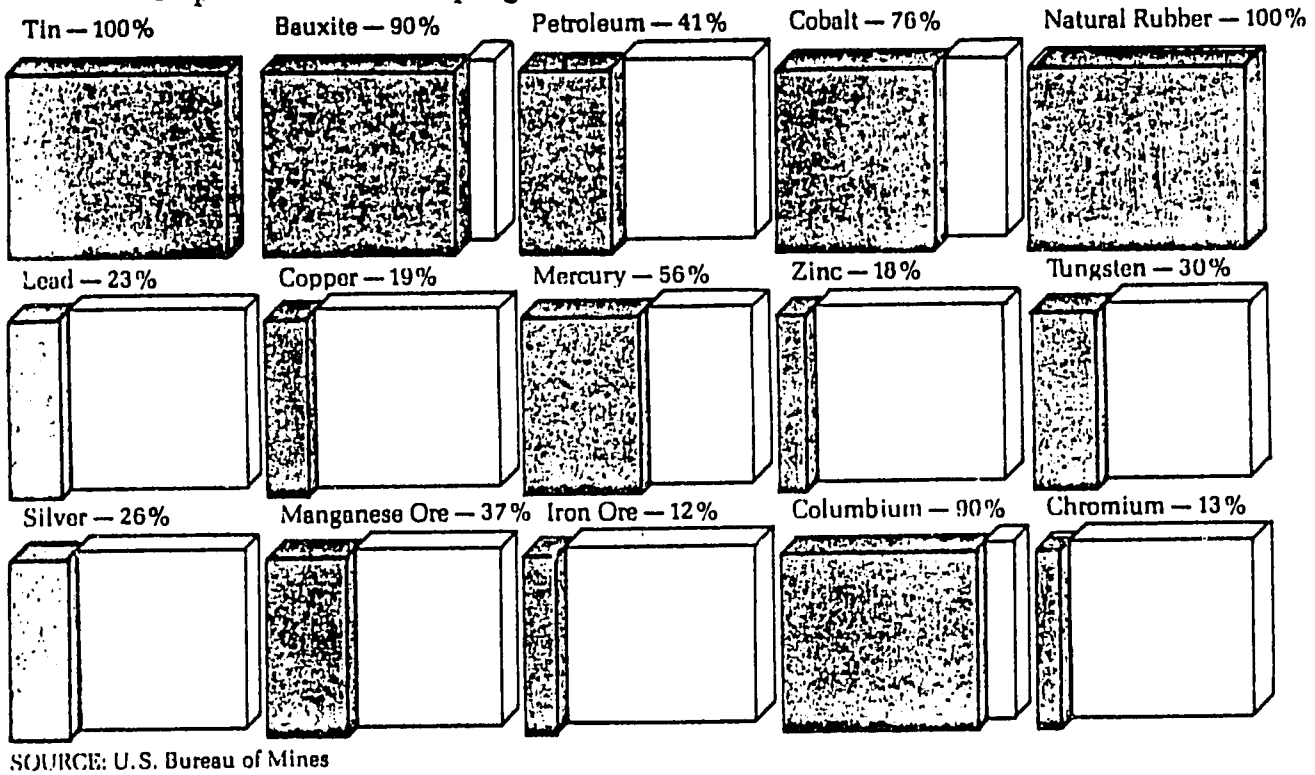
($ BILLION)

	U.S. TRADE WITH NON-OPEC LDCs			U.S. TRADE WITH OPEC COUNTRIES		
	U.S. Exports	U.S. Imports	Balance-of-Trade	U.S. Exports	U.S. Imports	Balance-of-Trade
1970	10.9	8.8	2.2	2.1	1.7	.4
1971	11.1	1.5	1.6	2.3	2.1	.3
1972	11.8	12.0	− .2	2.8	2.7	.1
1973	17.4	15.7	1.6	3.6	4.6	− 1.0
1974	26.0	23.8	2.2	6.7	15.6	− 8.9
1975	28.5	22.2	6.3	10.8	17.1	− 6.3
1976	26.7	28.0	−1.3	11.6	27.4	−15.8
1977	28.1	34.9	−6.8	12.9	35.8	−22.9
1978	35.4	41.1	−5.7	14.8	33.3	−18.5

SOURCES: Department of Commerce and *International Economic Report of the President*, 1977

On another level, as with petroleum supplies, sustained operation of U.S. industry is increasingly dependent on imported materials. The fraction of these obtained from LDCs is illustrated in the figure below.

RAW MATERIALS FROM DEVELOPING COUNTRIES USED IN U.S. INDUSTRY
Imports from Developing Countries as Percent of U.S. Consumption



SOURCE: U.S. Bureau of Mines

13. In addition to newer and renewable energy sources, substantially increased efforts are underway in fossil fuel exploration and development, as well as accelerated development of hydroelectric resources, notably in Latin America and Africa. These require integration with other developmental planning activities, and increasing attention to impacts on the environment and other economic activities. This opens new opportunities for econometric and policy analysis, institution-building, training and resource assessment studies, in addition to environmental and ecological work.

14. A major emphasis by the World Bank, AID and UNDP is in the 'traditional' fuel sector, covering reforestation and afforestation to deal with firewood shortages which have reached global crisis proportions. In conjunction with this, studies of improved efficiency of traditional fuel use, conversion processes for such fuels, development of marginal lands and integration of these forestry developments with other agenda such as watershed restoration and development of new associated industries are building rapidly.

15. The increasing developmental assistance program has lead to recognition by many other national laboratories and competing contract R&D organizations that international work is a discrete and major business. This is reflected in formal creation of International Divisions within BNL, ANL, SERI, SRI, AD Little and other organizations. This is based on federal and multilateral donors, rather than on sale of industrial R&D to foreign organizations using target countries' own money. This market is quite distinctive, and is not like the open country marketing coordinated by Battelle International Organization, which has emphasized developed and transitional economies and followed the industrial R&D pattern established in domestic work.

SPONSORING ORGANIZATIONS

Sponsoring agencies or organizations break down in the following categories:

- U.S. Government Agencies
- Multilateral Banks
- United Nations Organizations
- Private Sector Foundations and Companies

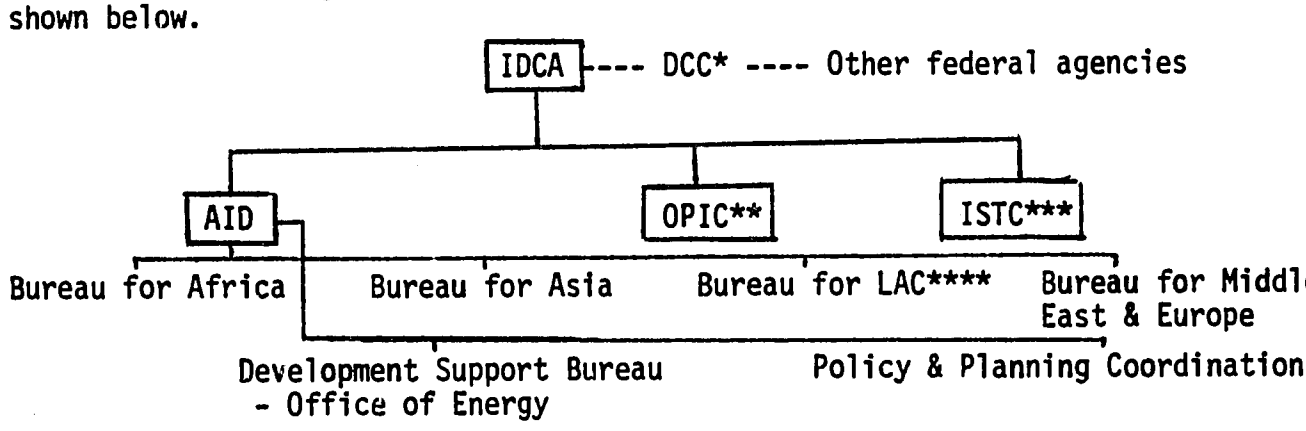
As noted earlier, the U.S. developmental assistance program is now centralized within a new agency, the International Development Cooperation Agency (IDCA), directed by Thomas Ehrlich. Ehrlich, who chairs the Development Cooperation Committee, has expanded authority as compared with the AID Administrator (now under Ehrlich within IDCA), notably with respect to interactions with the UN and with the World Bank. This increased integration, under IDCA, makes relationships between federal agencies increasingly interconnected and hard to cleanly sort out. In a sense, division of responsibilities is still being sorted out, and the situation remains confused (as noted earlier) by the apparent demise of the Institute for Scientific and Technical Cooperation. Bearing some uncertainties in mind, the major roles of U.S. federal government agencies are summarized below.

International Development Cooperation Agency (IDCA)

This replaces State as the center for developmental assistance, picking up roles from State, Treasury, Department of Commerce and USDA. Within IDCA, the major organizational structure remains the Agency for International Development (AID). AID in turn is divided into four major regional bureaus, a development support bureau serving all regional bureaus and a small office for policy planning and coordination.

The role of Regional Bureaus is execution of country programs. These are increasingly defined at the Mission level in-country, and flow to D.C. for implementation. This reverses a process of a few years ago where projects were defined in D.C. with comparatively little host country staff participation. In the energy field, these projects take the form of whole country alternative energy demonstrations, particularly in the rural sectors, along with substantial amounts of institution-building and resource assessment.

The Development Support Bureau provides centalized technical support to all bureaus, creating a technical baseline on all energy technologies. The Office of Energy is located within the Development Support Bureau, and so far forms our strongest line of entry into AID. The structure of IDCA is shown below.



notes: **Development Coordination Committee, ** Overseas Private Investment Corporation, *** Institute for Scientific and Technical Cooperation **** Latin America and the Carribean.

Distribution of funding by region is variable, particularly with respect to bilateral assistance directly administered by AID. The tables below summarize assistance by region, including contributions to the PL 480 (Food for Peace) grain purchases and contributions to multilateral agencies. For those who find this proliferating alphabet soup indigestable, a glossary is appended as a final page to this report.

REGIONAL SUMMARY—AFRICA
(In Millions of $)

	PROGRAM	FY 1979 (actual)	FY 1980 (estimate)	FY 1981 (request)
Bilateral	AID Development Assistance	248.3	337.0	393.1
	ISTC	—	NA	NA
	OPIC (ins.)	85.3	NA	NA
	(inv. guar.)	10.0	NA	NA
	PL 480[1]	170.0	198.0	205.0
	ESF	53.0	118.0	140.0
	IAF	—	—	—
	Refugees	7.2	25.0	54.0
	Subtotal	573.8	678.0	792.1
Multilateral	IDA	754.0	875.0	925.0
	IBRD	1,387.0	1,520.0	1,680.0
	IFC	6.0	NA	NA
	AFDB	270.0	316.0	NA
	AFDF	229.0	279.0	NA
	IFAD[2]	114.0	NA	NA
	Subtotal	2,760.0	2,990.0	2,605.0
	TOTAL	3,333.8	3,668.0	3,397.1

[1] Reflects commodity value only to tentatively identified recipient countries; excludes reserves.
[2] For CY's 78 and 79.

REGIONAL SUMMARY—ASIA
(in millions of $)

	PROGRAM	FY 1979 (actual)	FY 1980 (estimate)	FY 1981 (request)
Bilateral	AID Development Assistance	397.8	408.5	498.3
	ISTC	NA	NA	NA
	OPIC (ins.)	55.6	NA	NA
	(inv. guar.)	45.0	NA	NA
	PL 480[1]	466.0	445.0	382.0
	ESF	—	20.0	30.0
	Refugees	108.8	344.8	323.2
	Subtotal	1,073.2	1,218.3	1,233.5
Multilateral	IDA	2,115.0	2,450.0	2,590.0
	IBRD	2,092.0	2,280.0	2,520.0
	IFC	13.0	NA	NA
	ADB	842.0	900.0	1,550.0
	ADF	420.0	490.0	NA
	IFAD[2]	264.0	NA	NA
	Subtotal	5,746.0	6,120.0	6,660.0
	TOTAL	6,819.2	7,338.3	7,893.5

[1] Reflects commodity value only to tentatively identified recipient countries; excludes reserves.
[2] For CY's 78 and 79.

REGIONAL SUMMARY—EUROPE & NEAR EAST
(in millions of $)

	PROGRAM	FY 1979 (actual)	FY 1980 (estimate)	FY 1981 (request)
Bilateral	AID Development Assistance	42.5	37.8	56.8
	ISTC	NA	NA	NA
	OPIC (ins.)	139.3	NA	NA
	(inv. guar.)	—	NA	NA
	PL 480[1]	369.0	396.0	320.0
	ESF	1,912.4	1,865.1	1,860.0
	Refugees[2]	75.3	75.4	163.1
	Subtotal	2,538.5	2,374.3	2,399.9
Multilateral	IDA	121.0	140.0	148.0
	IBRD	1,278.0	1,368.0	1,512.0
	IFC	7.0	NA	NA
	IFAD[3]	50.0	NA	NA
	Subtotal	1,456.0	1,508.0	1,660.0
	TOTAL	3,994.5	3,882.3	4,059.9

[1] Reflects commodity value only to tentatively identified recipient countries; excludes reserves.
[2] Includes Soviet refugees to the United States.
[3] For CY's 78 and 79.

REGIONAL SUMMARY—LATIN AMERICA
(in millions of $)

	PROGRAM	FY 1979 (actual)	FY 1980 (estimate)	FY 1981 (request)
Bilateral	AID Development Assistance	246.5	241.3	275.2
	ISTC	NA	NA	NA
	OPIC (ins.)	23.7	NA	NA
	(inv. guar.)	6.3	NA	NA
	PL 480[1]	136.0	152.0	160.0
	ESF	8.0	65.0	25.0
	Refugees	.8	.9	1.0
	Subtotal	421.3	479.2	461.2
Multilateral	IDA	32.0	35.0	37.0
	IBRD	2,233.0	2,432.0	2,688.0
	IFC	27.0	NA	NA
	IBD	1,125.0	1,280.0	1,535.0
	FSO	775.0	715.0	625.0
	IFAD[2]	65.0	NA	NA
	Subtotal	4,257.0	4,462.0	4,885.0
	TOTAL	4,678.3	4,941.2	5,346.2

[1] Reflects commodity value only to tentatively identified recipient countries; excludes reserves.
[2] For CY's 78 and 79.

AID's activities are directed to lower income countries. Assistance is broken into two categories. The larger, termed "Developmental Assistance,' is directed toward 'basic human needs,' at the direction of the U.S. Congress. The second type of assistance, termed 'Security Supporting Assistance,' is awarded on the grounds of U.S. national interest to stabilize economies of countries of particular strategic or other importance. Criteria for projects are looser in the latter category.

Maps on the following pages identify countries of interest to the regional bureaus, wherein AID has active projects and maintains field missions. Although these particular maps are from the FY 80 presentations to Congress, the situation is unchanged.

The table below breaks down AID's energy program by type of activity and by fuel form or conversion. Data for both FY 80 and 81 are given.

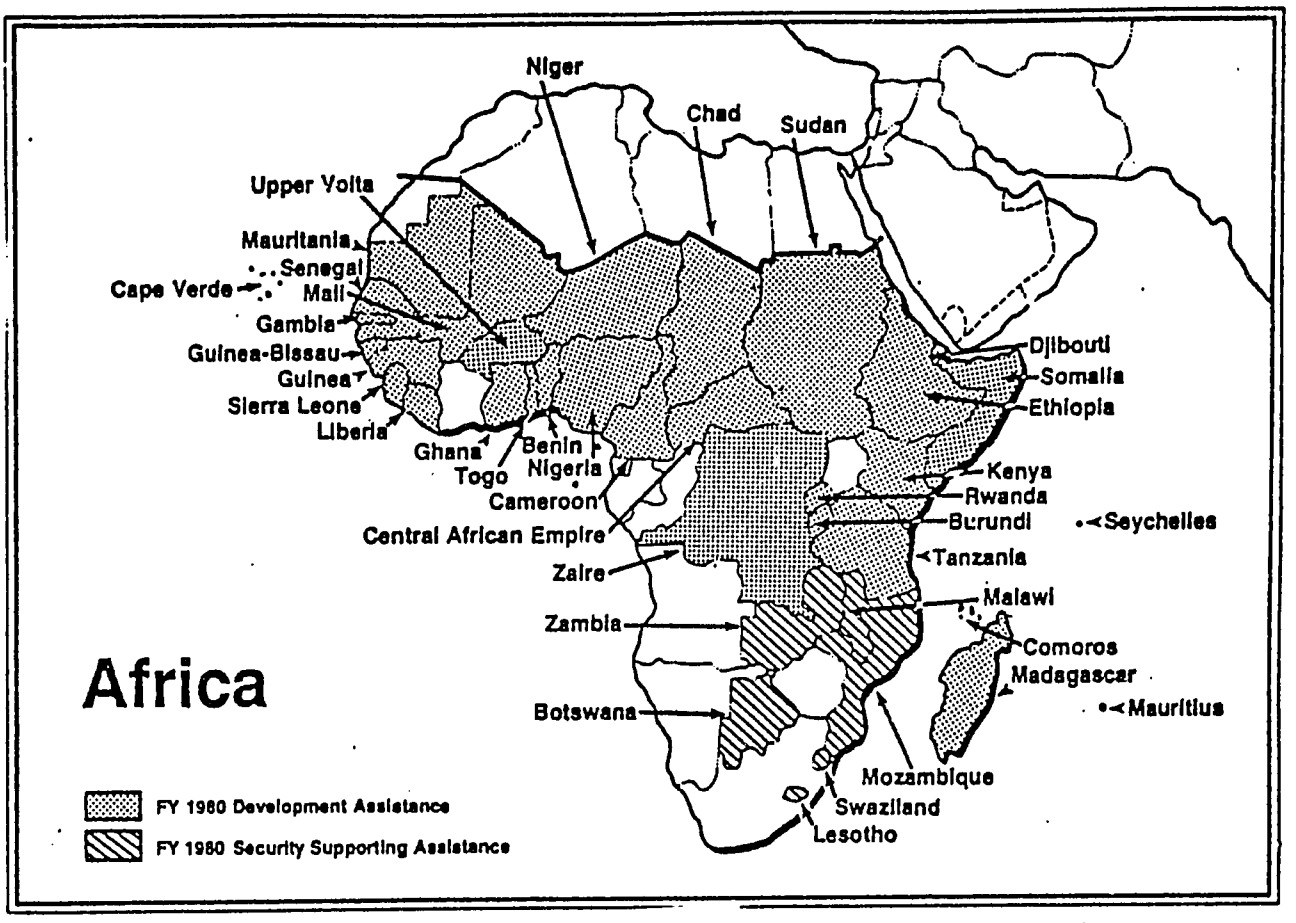
AID Energy Projects by Type,
millions of dollars, FY 80 (FY 81)

	Fossil Fuel	Power Generation	Fuel Wood
R&D	- (-)	- (-)	- (-)
Assessment & Planning	0.7 (3.6)	- (-)	0.6 (0.5)
Training	1.4 (2.7)	0.2 (-)	1.2 (2.1)
Institution-building & Tech. Assistance	1.0 (6.6)	- (-)	2.2 (2.3)
Capital Financing	- (-)	20 (25)	5.3 (11.1)

	New & Renewables	Total
R&D	4.5 (19.9)	4.5 (19.9)
Assessment & Planning	2.3 (4.0)	3.6 (7.5)
Training	2.8 (5.6)	5.5 (10.4)
Institution-building & Tech. Assistance	6.6 (16.6)	9.9 (25.5)
Capital Financing	1.8 (3.8)	27.1 (39.9)

Source: IDCA FY 81 Presentation to Congress

Fastest growing activity is in the new and renewable category, with a 342% increase in R&D funding, and marked increases in other activities as well. Summing expenditures in areas wherein we might reasonably capture the work, the market size for FY 81 is about $60 million through AID.


Africa
Niger
Chad
Sudan
Upper Volta
Mauritania
Senegal
Cape Verde
Mali
Gambia
Guinea-Bissau
Guinea
Sierra Leone
Liberia
Ghana
Togo
Benin
Nigeria
Cameroon
Central African Empire
Zaire
Zambia
Botswana
Djibouti
Somalia
Ethiopia
Kenya
Rwanda
Burundi
Seychelles
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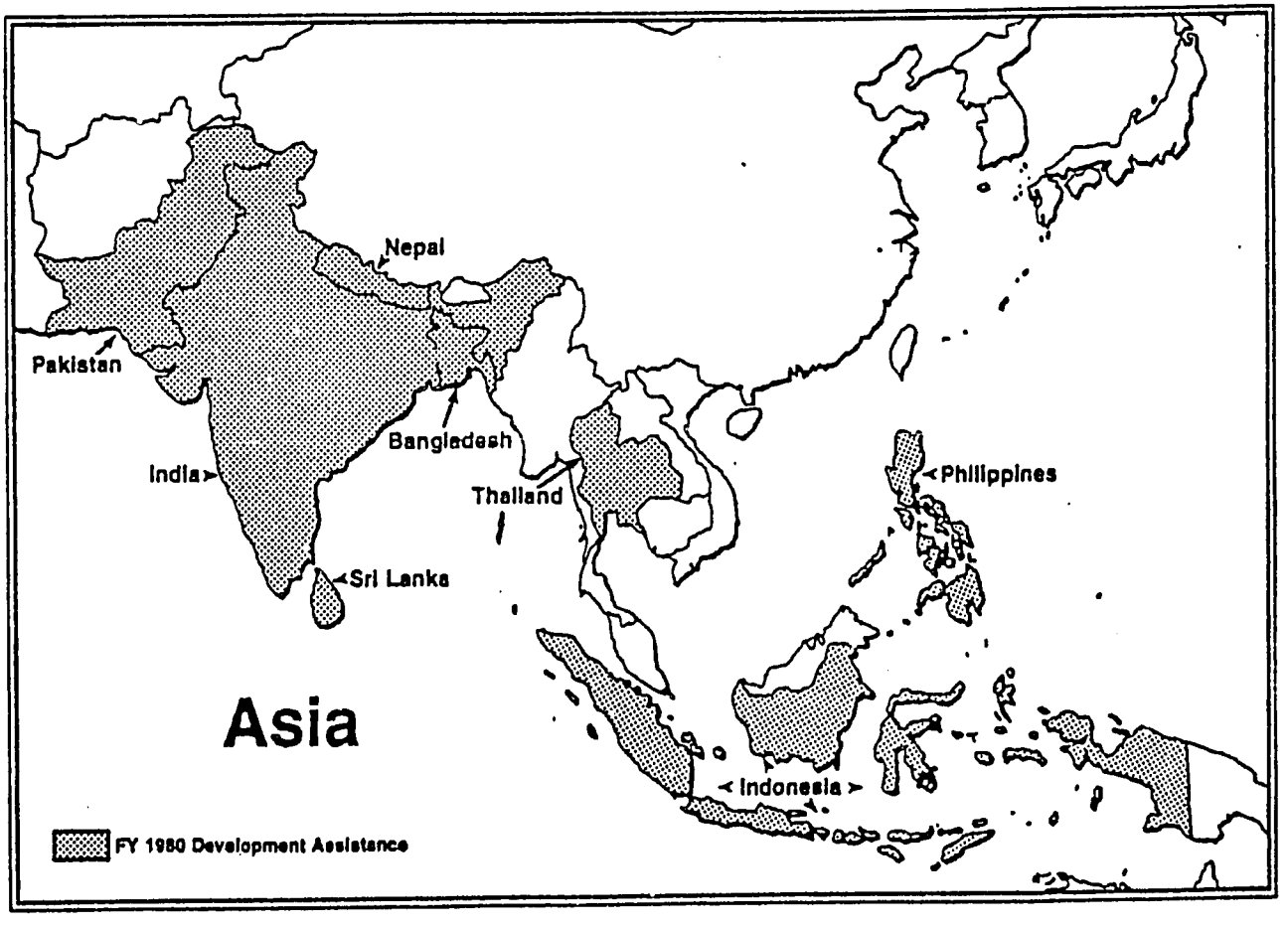
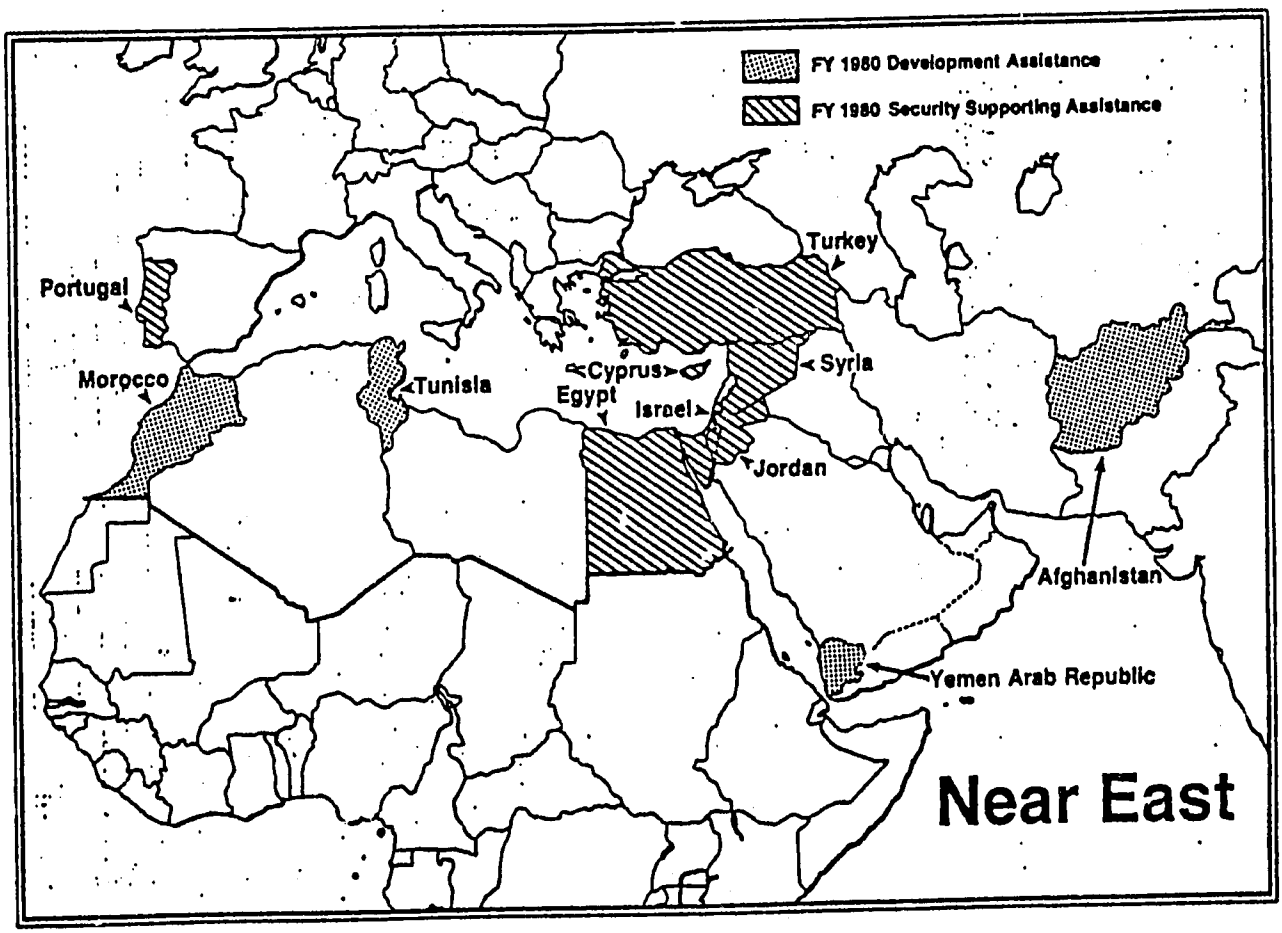
Malawi
Comoros
Madagascar
Mauritius
Mozambique
Swaziland
Lesotho
FY 1980 Development Assistance
FY 1980 Security Supporting Assistance


Asia
Nepal
Pakistan
Bangladesh
India
Thailand
Philippines
Sri Lanka
Indonesia
FY 1980 Development Assistance

Honduras
Haiti
Dominican Republic
Jamaica
Guatemala
Nicaragua
El Salvador
Guyana
Costa Rica
Panama
Ecuador
Peru
Latin America and the Caribbean
Bolivia
Paraguay
FY 1980 Development Assistance


FY 1980 Development Assistance
FY 1980 Security Supporting Assistance
Turkey
Portugal
Syria
Morocco
Tunisia
Cyprus
Egypt
Israel
Jordan
Afghanistan
Yemen Arab Republic
Near East

Additional, so-called 'pipeline' funds from prior appropriations remain in the system and do not appear in the tabulation above. For example, a $1.8 million authorization was made to USDA in CY 79 to execute portions of the AID biomass program. So far, only about $500,000 of these funds have been committed, primarily for state-of-the-art surveys of technology (Battelle has done 3 out of 10 of these - two at BNW and one at BCL). We know that about $1.3 million of this funding remains for additional work, including some applied R&D. Our involvement in the early phases of this work, contacts within both AID and USDA, should lead to expansion of work on biomass problems.

Department of State

Creation of IDCA has reduced the State Department role in developmental assistance. Some roles remain in State, notably the identification of specific countries (signatories to the Nuclear Non-Proliferation Treaty) for resource assessment and planning studies executed by the DOE International Affairs Division (discussed later under DOE). In addition, State still coordinates U.S. responses to major international gatherings, such as the UN Conference on New and Renewable Sources of Energy to be held in Nairobi, Kenya in August, 1981. The State conference coordinator interacts with staff in AID (Office of Energy), DOE International Affairs, DOE Office of Scientific and International Programs, Department of Commerce and other concerned agencies. Some interfacing is maintained with the World Bank and International Monetary Fund as well, and with Treasury, on financial recommendations and plans.

In matters concerning U.S. security, strategic or diplomatic considerations, the Director of IDCA consults with the Secretary of State. Several elements dealing with economic affairs, international organizations, international environmental and scientific affairs, security assistance and other such matters remain within the Department of State.

Funding in international work we might capture is probably confined to some conference preparation money for specialized working group activities, some policy and planning analysis work, and perhaps some extension of the type of technology demonstrations at foreign missions and embassies exemplified by the small wind machine study we're doing now.

This agency is probably not a primary target for market development, although contacts within State are useful in tracking activities within other federal agencies and the multilateral banks, as well as the UN.

National Science Foundation

For some time the National Science Foundation (NSF) has been involved in international work. Major ways include:

- Administration of bilateral agreements establishing binational science foundations; e.g., U.S./Israel.
- Execution of cooperative programs for AID; e.g., the Science and Engineering for Economic Development (SEED) program.
- Traditional cooperative research wherein a clear domestic benefit is visualized.

An office for Appropriate Technology has been established within NSF, and a number of regional conferences on Appropriate Technology have been held around the U.S. This is seen as a domestic program, but work may be done in LDCs which have established leads in some technologies.

NSF appears to be staying clear of purely energy-related appropriate technology, but is open to broader topics tied to processes or applications which include energy.

This agency is not a primary target for us. However, there are two things which might receive some attention. First, although the SEED program is nearly dead, there are some countries where U.S.-owned local currency is available in embarrassing amounts (e.g., India and Egypt), and these funds are comparatively easy to get for traveling and project discussions with peers in those countries. A second consideration in U.S.-owned currency revolves around the idea of creating additional bilateral science foundations. Some fairly high level discussions with ex-Battelle staff like Lederman at NSF, presenting the idea of KIST-like applied R&D organizations in these two countries might help get the possibility of new bilateral agreements off center. Other agencies, like State, and the governments of the host countries need to be involved.

Types of awards under the NSF Science in Developing Countries Program are categorized in NSF 80-6 as follows:

"-RESEARCH PARTICIPATION GRANTS to support
- (a) the participation of U.S. scientists or engineers in a research project in an eligible, developing country;
- (b) the participation by scientists or engineers from an eligible developing country in an appropriate U.S.-based research project; or
- (c) a combination of these

-CONFERENCE GRANTS to support national, regional and international
- (a) SEMINARS that are research-oriented and focused on developing-country problems;
- (b) WORKSHOPS concerned with the planning and initiation of cooperative research activities; or
- (c) COLLOQUIA at which U.S. and counterpart scientists or engineers who are involved with state-of-the-art research explore the application of science and technology to development problems.

-DISSERTATION IMPROVEMENT GRANTS for the incremental support of developing-country graduate students who are enrolled at U.S. universities and qualified to undertake a dissertation research project. Only projects related to a developing-country problem and approved by a U.S. research advisor will be considered for support."

The total budget for NSF's international work is comparatively small (probably on the order of 8 to 10 million $), and is dispersed across a broad spectrum of exchange and special currency programs. Awards are small, and this sponsor can be looked to in minor ways for some travel and collaboration possibilities, support of individual contributors and perhaps some conference-type activities.

United States Department of Agriculture (USDA)

USDA executes portions of the AID Biomass program under an agreement with the Development Support Bureau's Office of Energy. USDA has also been for some years the principal executing agency for the PL 480 (Food for Peace) legislation, and has been closely associated with AID in a number of rural sector programs.

We have received $37,800 in support through USDA's AID-assigned work. The bulk of the original $1.8 million appropriation to USDA is still in place for biomass technical assistance, and remains an open market for us.

Department of Energy (DOE)

DOE has an international role which is divided between the International Affairs Division and the Office of Scientific and International Affairs within Conservation and Solar.

The International Division has two major roles:

- Interfacing for the U.S. in information exhange and other activities of the International Energy Agency (part of the Organization for Economic Cooperation and Development - OECD)
- Execution of the President's International Energy Development Program

The latter activity consists of whole country resource assessment and planning studies for signatories of the Nuclear Non-Proliferation Treaty. Countries are prioritized by the Department of State, and DOE then performs studies in cooperation with host country counterpart teams. The lead role in two completed studies (Egypt and Peru) and in two currently active country programs has been Argonne National Laboratories. The budget for this activity has been cut to $2 million, essentially committed to Argonne. Problems exist due to the backlog of countries, which are released by State at the rate of about 3 per year. Completed studies cost on the order of $1.2 to 1.6 million each, and were completed in about 16 months time each.

We have been discussing the possibility of a Battelle (PNL) lead in the International Energy Development Program. Due to present budget restraints, near term prospects are not good. However, a re-design of the program which will meet needs at less cost and in less time would be of great interest to DOE and State.

The Office of Scientific and International Programs is responsible for execution of bilateral energy agreements between the U.S. and other countries. In addition, this office is the main linkage with AID in responding to AID requests for technical assistance. In both of these cases, Solar Energy Research Institute (SERI) has the lead role. SERI solicits and awards work to other national labs and to the private sector for bilateral energy projects. The largest of these is a 5-year Solar Energy agreement with Saudi Arabia, funded at $100 million. Through DOE, SERI manages a demonstration in renewable energy in Mali for AID (5-year, $5 million project).

BCL bid on a PV village in Saudi Arabia RFP from SERI, finishing in the final round of negotiations, but ultimately was edged out by Martin Marietta. BNW's wind capabilities had been factored into a Syrian agreement through discussions with SERI, but this has floundered with reversals in relationships between the two governments.

Discussions are still active with both parts of DOE, and with SERI.
In addition to a prime role in the International Energy Development Program, we have been discussing energy institution building activities (similar to the Korea Institute for Science and Technology project) and as a precursor to this, a series of international conferences and workshops to define needs in LDCs for new institutions.

A breakdown of the bilateral energy program by technology and country, with preliminary detail on FY 81 funding, may be found on the following pages.
A complete description of the International Energy Development Program may be found in the DOE document 'Cooperative Energy Assessments with Developing and Industrializing Countries,' dated April, 1980

DOE Bilateral Energy Agreement Activities

BIOMASS

COUNTRY & PROJECT	FY 1980	FY 1981
AUSTRALIA - Harvesting and Conversion of Biomass to Ethanol. (Proposed project under DOE consideration.)	Funding from DOE Support	.10
BRAZIL - Cooperation in the area of Biomass Production and/or Conversion to Alcohol Fuels on Petrochemical Substitutes. (DOE in process of making specific recommendations for cooperative projects.)	.20	.50
IEA - o Forestry Energy R&D o Biomass Information System	.10	.12 (+.08)
ISRAEL - Proposed Projects: o Anaerobic Digestion o Microbiology of Digestion Processes o Pathogens in Digestion Processes	.90	1.10
MEXICO - Neighborhood Scaled Home-Use Fuels Production. (DOE anticipates the development of other biomass projects.)	.10	.10
SAUDI ARABIA - Evaluative Study of Potential Biomass Applications in Saudi Arabia	.20	------
SERI INTERNATIONAL PROGRAMS	.10	.30
INFORMATION EXCHANGE & DOE SUPPORT	.13	.02 (+.08)
TOTAL FUNDING FROM BIOMASS	1.73	2.24
BIOMASS ALLOCATION FROM INTERNATIONAL SOLAR TECHNOLOGY LINE ITEM		(+.16)
TOTAL BIOMASS TECHNOLOGY FUNDING		2.40

WIND

COUNTRY & PROJECT	(in $ millions) FY 1980	FY 1981
AUSTRALIA -	DOE Support	.05
CHINA o Potential System Applications Analysis	DOE Support	.10
IEA - o Wind Energy R&D o Large-Scale Wind Turbine Information Exchange	.30	.18 (+.12)
MEXICO o Wind Systems	.05	.10
SAUDI ARABIA	.40	.22 (+1.98)
SERI INTERNATIONAL PROGRAMS	.15	.30
INFORMATION EXCHANGE & DOE SUPPORT	.12	.05 (+.12)
TOTAL FUNDING FROM WIND	1.02	1.00
WIND ALLOCATION FROM INTERNATIONAL SOLAR TECHNOLOGY LINE ITEM		(+2.22)
TOTAL WIND TECHNOLOGY FUNDING		3.22

PHOTOVOLTAICS

COUNTRY & PROJECT		(in $millions) FY 1980	FY 1981
AUSTRALIA		DOE Support	.05
CHINA	o Potential System Applications Analysis	DOE Support	.10
IEA			.12 (+.08)
ISRAEL	o Luminent Concentrator Photovoltaic Systems	.10	.30
ITALY	o System Field Experiments with two Parallel 20kW Isolated Power Systems	.09	(+.70)
	o Photovoltaic and Solar Thermal Component Testing		
	o Small Photovoltaic System Field Experiment		
	o R&D Exchange in Photovoltaics		
MEXICO	o Mexico Solar Village	.10	.20
	o Photovoltaic Systems Research		
	o Insolation Measurements		
SAUDI ARABIA	o Saudi Village Photovoltaic Power System Project	6.60	.30 (+2.70)
SERI INTERNATIONAL PROGRAMS		.70	.40
INFORMATION EXCHANGE & DOE SUPPORT		.21	.10 (+.23)
	TOTAL FUNDING FROM PV	7.80	1.57
	PV ALLOCATION FROM INTERNATIONAL SOLAR TECHNOLOGY LINE ITEM		(3.71)
	TOTAL PV TECHNOLOGY FUNDING		5.17

THERMAL

(IN $ MILLIONS)

COUNTRY & PROJECT	FY 1980	FY 1981
AUSTRALIA - Proposed Projects:		
o Thermal Energy Storage in Horizontal Air Flow Rock Beds	DOE Support	.05
o Development of Passive Solar Energy System Components		
CHINA (PRC) o Potential System Applications/ Analysis	DOE Support	.10
FRANCE o Information Exchange	.10	.10
IEA o Solar Heating and Cooling R&D	6.10	1.20
o Small Solar Thermal Power Systems		(+.80)
ISRAEL o Passive System Development and Testing	----	1.60
o Salt Gradient Solar Pond		
o Saturated Solar Pond		
ITALY o Photovoltaic and Solar Thermal Component Testing	.12	(+.50)
o System Field Experiments with Two Parallel 20 kw Isolated Power Systems		
o Utility Applications Study of Solar Central Receiver Technology		
o Design and Testing of Passive Solar Systems & Components		
MEXICO o Passive-Solar Applications	.05	.10
o Solar Refrigeration of Foods and Medicines		
SAUDI ARABIA o Engineering Field Test of Active Cooling	.70	.38
o Saudi Arabian Solar Cooling Project		(+3.32)

THERMAL - CONT'D

COUNTRY & PROJECT	FY 1980	FY 1981
SERI INTERNATIONAL PROGRAMS	.20	.40
INFORMATION EXCHANGE & DOE SUPPORT	.10	.05 (+.10)
TOTAL FUNDING FROM THERMAL	7.37	3.98
THERMAL ALLOCATION FROM INTERNATIONAL SOLAR TECHNOLOGY LINE ITEM		(+4.72)
TOTAL THERMAL TECHNOLOGY FUNDING		8.70

OTEC

COUNTRY & PROJECT	FY 1980	FY 1981
BRAZIL o Potential Ocean Resource Study	DOE Support	.10
IEA o Wave Power System Development and Testing	.10	.18 (+.12)
IVORY COAST -	.60	.10
SAUDI ARABIA -	.10	--
SERI INTERNATIONAL PROGRAMS	.10	.10
INFORMATION EXCHANGE & DOE SUPPORT	.05	.03 (+.07)
TOTAL FUNDING FROM OTEC	.95	.51
OTEC ALLOCATION FROM INTERNATIONAL SOLAR TECHNOLOGY LINE ITEM		(+.19)
TOTAL OTEC TECHNOLOGY FUNDING		.70

TECHNOLOGY FUNDING SUMMARY
(DOE Bilateral Program)

	FY 1980	FY 1980		
		Technology	International Technology	Total
BIOMASS	1.73	2.24	.16	2.40
WIND	1.02	1.00	2.22	3.22
PV	7.80	1.57	3.71	5.28
THERMAL	7.37	3.98	4.72	8.70
OTEC	.95	.51	.19	.70
TOTALS	18.87	9.30	11.00	20.30

To these categories, from another source, might be added two agreements on geothermal energy:

- Italy for five projects as follows:
  - Project 1 - Stimulation of hot dry rock and hydrothermal reservoirs
  - Project 2 - Utilization of hot brine resources
  - Project 3 - Reservoir Physics and Engineering
  - Project 4 - Deep Drilling
  - Project 5 - Environmental Control Technology
- Mexico for survey of the Cerro Preito geothermal field in order to determine the most economic and productive methods for further developing the reservoir.

Other geothermal agreements with New Zealand and the USSR are currently inactive.

Topics under the International Energy Agency (DOE International Affairs Division) include a number of demonstration projects as well as information exchange activities. IEA projects are distinguished by having lead countries control what happens and who performs work. The U.S. so far has few leads. IEA projects are listed without elaboration as follows:

- Small Solar Thermal Power Systems (lead Federal Republic of Germany)
- Large Scale Wind Energy Conversion System
- Wind Energy Conversion System R&D
- Forestry Energy
- Biomass Conversion Technical Information Service (lead Ireland)
- Wave Power (lead Japan)
- Manmade Geothermal Energy Systems
- Hydrogen Production and Use
- Seasonal Waste Heat Storage Systems
- Heating and Cooling

Several of these contain a number of annexes. U.S. leads, where established, for the main part follow national lab lead roles in the domestic program.

International Bank for Reconstruction & Development (IBRD)

The IBRD, commonly known as the World Bank, is the largest of the multilateral banks. The group collectively known as the IBRD includes the World Bank, the Interamerican Development Bank (IDB) and the International Development Association (IDA). The latter is a special entity for extending low or no interest credits to the lowest income developing countries.

Historically, the Bank's main role in energy has been to fund large power projects and distribution systems. To a lesser degree, the Bank has funded rural electrification projects.

Over the last year, Bank staff have been generally looking at the impact of oil price and availability on economic development in LDCs. Present plans are to accelerate energy development beyond the earlier projection of $13 billion over the five-year period 1981-85 to a desired level of $25 billion over the same period. In addition, the Bank has formulated new policy which expands its role in loan and credit assistance for energy exploration and development. Putting this in perspective, the Bank estimates a required investment in the oil-importing LDCs of $450 - 500 billion over the next decade for energy development.

Establishment of a new, energy affiliate of the Bank is now under active consideration.

As a point of historical interest, the table below summarizes World Bank lending in the electric power generating sector. The FY 80 plan represents an increase, in constant dollars, of 83% over the 1976-78 average.

WORLD BANK ELECTRIC POWER LENDING, FY1976-80
(Million current US dollars)

	FY1976-78 Annual Average	FY79	FY80
Hydro	247	183	782
Coal/Lignite Thermal	150	495	840
Oil Thermal	94	24	0
Gas Thermal	4	219	57
Geothermal	6	9	40
Transmission and Distribution	439	191	580
Rural Electrification	74	234	93
Total	1,014	1,355	2,392
Note:			
In Constant 1980 US Dollars	1,307	1,458	2,392
Number of Projects	19	19	25

Source: Energy in the Developing Countries, World Bank, August, 1980.

A breakdown on the current and desireable World Bank energy lending programs is given on the following page. This table, and the preceeding one, come from Energy in the Developing Countries, issued in August 1980, and representing Bank policy (i.e., it is not a staff working paper with disclaimers attached). There are a number of statements and plans detailed in this report which relate to services Battelle might provide. Some extracts are given below:

"Sector Reviews
4.16 An expanded program of energy sector reviews is planned to assist oil importing developing countries in devising energy plans and to support the Bank's lending programs in FY 81-85. During the first half of this period 40 energy sector reviews will be carried out, of which 26 will be in countries which depend heavily on imported oil. With the completion of these reviews, and those already carried out in FY 79-80, the Bank will have covered most of the 60 oil importing developing countries believed to be in need of assistance in energy planning. Several studies of energy subsectors within countries will also be made during this period. The program of energy reviews will be continued in the following years, in part to cover other countries in which the Bank proposes to lend, and in part to update reviews made earlier."

"4.17 Assistance will also be given to member countries on a wide range of energy questions including, for example, the formulation of exploration policies, the choice of technologies, resource and market surveys, training, and advice on contracts with foreign companies and other legal matters. Where possible, assistance will be included as components of energy loans or credits, but on occasion a separate technical assistance loan or credit comprising several of the activities mentioned, may be appropriate."

With respect to the last comment in 4.17 above, it might be noted that the Bank spends several hundred million $ for technical assistance activities outside of projects. FY 78 expenditures on such assistance were $250 million. However, as noted, the majority of technical assistance expenditures are included as one of several elements within project loans or grants. Since energy constitutes (now) about 17% of Bank activity, one might suppose a total technical assistance budget on the order of $350 million, of which about $60 million might be the energy element.

Quoting again from the Bank report:

"4.27 Renewable energy holds considerable promise for the developing countries and should therefore occupy an important place in the Bank's program.... It includes increased lending, sector work and research."

"4.28 [fuelwood] .... The fuelwood program would concentrate on expanding planting and production, strenthening sector institutions, training manpower, and testing technical inputs and extension techniques.... small pilot projects [Bank's idea of small is up to $4 million] ... would be designed as technical assistance projects."

"4.29 [other types of renewable energy] ... solar thermal and electric technologies, hydro and wind power from small units, and other applications of biomass and biogas technologies.... Given the technical and economic uncertainties and the Bank's lack of experience in this area, the Bank will seek to gain operational experience... to build capacity in developing countries to design and implement future programs."

CURRENT AND DESIRABLE WORLD BANK ENERGY LENDING PROGRAMS, FY 1981-85

(Million current US dollars)

	Current		Desirable	
	Lending Program	Total Project Cost	Lending Program	Total Project Cost
Coal and Lignite /a	840	4,270	2,000	7,350
Oil and Gas				
Predevelopment	1,020	2,610	2,410	5,850
Oil Development /b	1,755	5,900	3,320	12,150
Gas Development /c	1,210	3,250	2,270	5,875
	3,985	11,760	8,000	23,875
Refineries	150	400	1,000	3,100
Renewables				
Fuelwood	425	850	1,100	2,200
Alcohol	200	2,100	650	4,550
	625	2,950	1,750	6,750
Electric Power	7,590	37,950	11,000	47,450
Industrial Retrofitting	0	0	1,250	3,825
TOTAL	13,190 /d	57,330	25,000 /d	92,350
Bank Share of Total Project Cost (percent)		23		27

/a Includes coal gasification projects.
/b Includes heavy oil projects.
/c Includes methanol.
/d Does not provide for any lending to China.

Note: On completion, the projects included in the Current Lending Program are estimated to produce (or in the case of electric power and industrial retrofitting projects, to save) energy equivalent to 1.62 million barrels of oil per day (mbdoe) or 5.3 percent of the developing countries' projected energy consumption in 1990. The corresponding estimates for the Desirable Lending Program are 2.9 mbdoe and 9.5%, respectively. Refineries, which add substantially to the value of petroleum products but not to energy output or savings, are excluded from the calculation.

Source: Energy in Developing Countries, World Bank, August, 1980.

The major opportunities for Battelle from the broadened scope and level of effort of the Bank's activity come in the sectoral analysis tasks, technical assistance on major conversion technologies and in the conduct of field demonstration projects. These latter may be small by Bank standards, but are large on the scale of commitments by most other sponsors. The Bank's admitted lack of experience in newer energy technologies means that they must reach out for assistance, opening what has mainly been a closed club of in-house specialists and established consultancy arrangements to new players.

In addition to its own program, the IBRD executes projects for the United Nations Development Program. These are in the nature of exploratory demonstration or feasibility studies, requested by host countries through UN organizations. In executing these projects, the Bank makes contract awards for goods and services.

United Nations Development Program (UNDP)

The UNDP is the world's largest multilateral development program. Its principal mission is provision of technical assistance, and it is increasingly involved in energy projects.

The UNDP second programming cycle (1977-81) is projected at $3.5 billion, and now runs at about $700 million per year from baseline UNDP funds. The UNDP interacts with 26 UN-affiliated agencies, and administrates several of these, including the United Nations Industrial Development Organization (UNIDO) and the UN Capital Development Fund. In addition, the UNDP is responsible for execution of the Special Interim Fund for Science & Technology, which has a target funding of $250 million for two years.

Thus, total funding for technical assistance, technology transfer and other types of assessment and planning work of the sort we might do lies close to $ 1 billion in FY 81.

In addition, the UNDP has just established a new Energy Fund for Exploration and Pre-Investment Surveys to assist low-income developing countries both with fossil fuel exploration and with the identification of newer energy alternatives, particularly where the latter are seen as capital-intensive.

The UNDP has become involved with multisectoral economic analysis as well, in some ways paralleling the DOE International Affairs Division's International Energy Development Program. These types of study are increasingly coordinated with the activities of other agencies, such as AID, and with uses of various funds within the UNDP. An example is the Thailand energy planning effort, which combines field experimentation and agricultural sector analyses funded by AID with a UNDP-funded analysis of the commercial/industrial sectors of the Thai economy. As a practical matter, these complementary efforts are worked out by country-based UNDP and AID mission staff in cooperation with the host government.

UNDP sectoral analysis projects and feasibility studies are often executed by the multilateral banks, such as the World Bank, or, as in the case of the Thailand project, by regional banks (Asian Development Bank).

Bradford Morse, Director of the UNDP, supplied a partial listing of energy projects that is rather lengthy. Paulette Gemmill reviewed this and extracted a representative listing which emphasizes policy and planning studies. This is reproduced in the table below.

Representative UNDP Assessment Projects

Support to Energy Study	$183,461	1974-78
Studies on Non-Petroleum Fuels	7,362	9/77-9/77
Study on Production of Gas & Chem.	79,500	1977-78
Alternative Energy Mission Development Study	18,000	1978-79
Energy Planning & Policy	200,995	1978-80
Energy Conservation Study	383,500	1978-80
Power Sector Survey	904,000	1976-79
Energy Survey & Policy	587,580	1980-82
Hydro Power Survey	858,931	1974-77
Energy Planning	627,668	1977-81
Energy Planning & Policy	205,584	1978-82
Rural Energy Development	47,000	1979-79
Energy Conservation	95,130	1975-80
Energy Policy Study	235,000	1978-79
Energy Master Plan	235,000	1979-81
Overall Energy Assessment	146,625	1979-80
	$4,815,336	

In passing, the amounts shown above represent only the UNDP contributions to projects, which may in some cases be supplemented by host country funds, bilateral donor assistance or multilateral bank credits or loans.

TYPES OF PROJECTS BEING FUNDED

Projects may be broken into a number of categories, basically contained in the listing below:

- Physical resource assessment and planning studies
- Technical assistance & training
- Institution building
- Applied R&D
- Technology Transfer
- Field projects for demonstration
- Information exchange
- Policy development and assessment

Since some rather detailed discussion of the roles of various sponsors has been presented in the preceeding section, some brief comments on representative projects under these categories are provided below as illustrative rather than exhaustive.

Physical Resource Assessment & Planning Studies

The DOE International Energy Development Program's Country Energy Assessments are the most comprehensive of this type of project. They range up to $1.6 million per country, and are performed by multidisciplinary teams over 16-month contract periods. The output is a complete catalog of energy resources, to the extent discoverable from existing information, as well as forecasts of energy needs based on host-country development plans, existing econometric data and some field observations of current industrial practices. Energy reference systems are created, combining a number of sources and conversion technologies, to select a path fitting the available funding, manpower and technical infrastructure for the country's development.

The UNDP does similar kinds of multisectoral analysis projects to define current energy uses. These appear to be somewhat less extensive, and are funded on the order of $250-300 K each.

Assistance in specific types of resource assessment and development cost analysis are also funded by a number of sponsors, such as the UNDP, World Bank and AID. These may be limited to a particular resource (oil, gas, coal, geothermal, wind, hydro, etc.), or to a limited mix of resources of primary interest or uncertainty.

Such projects combine the talents of economists and policy analysts with those of hard scientists and engineers. The latter provide an assessment of the quality of data (e.g., on geologic resources, water, wind, etc.), and in the case of process specialists, some appraisal of the prospects for manufacturing process optimizations or substitutions to reduce energy demands. Specialists also are needed to provide input on current costs of various newer energy source technology, as well as prospects for substantial changes in costs.

Such projects call for some brief field work and cooperation with host country peers, but travel is normally for short term interactions only, involving at most 4 to 6 weeks in-country for key staff.

Technical Assistance & Training

This is a highly diversified topic, including all of the diversified services we normally provide to domestic sponsors under Technical Services Agreements. Basically, any provision of specialized knowledge on methodology, detailed data on technoeconomic advantages of various technologies for mining, energy production or conversion, distribution or modification of current manufacturing processes fit into this category.

Major sponsors for low capital investment types of projects, centered on what is popularly known as 'appropriate technology', are the Regional and Development Support Bureaus within AID, the UNDP and the multilateral banks.

Training programs are a major role of AID, but this activity is expected to expand through the UN Special Fund for Science & Technology as this becomes operational.

Large capital investment projects lie outside the U.S. federal establishment, and are chiefly the role of the multilateral banks and the UNDP.

Examples might include the following types of activity:

- Conduct of regional wind assessments, with some transfer of methodology through participation by host country staff. (Two regional surveys, at $600 K each, have been suggested to the UNDP by Atmospheric Sciences staff)
- Siting methodology for small wind energy systems
- Siting for large wind turbines
- Methodology for assessing sites for large hydro or thermal plant construction, including ecological costs
- Selection of specific approaches for coal or biomass conversion
- Assistance in identifying mining equipment options for accelerated mineral development
- Applications of newer manufacturing technology to conserve energy
- Techniques for econometric modeling and developmental forecasting

Comprehensive combinations of many of these types of services can be made in conduct of whole country alternative energy programs. These may include elements drawn from other categories as well. Examples include the Thailand Alternative Energy Program, which covers some resource assessment (primarily renewables), provision of technical assistance to the Thai counterpart staff and field demonstration of small scale, renewable energy conversion hardware in 18 villages. This is a 4-year project, currently funded at about $4 million, of which $1.5 to 2 million is available to the U.S. prime contractor. The balance is used for hardware and local costs, and remains under AID Mission control. The scope and control of funding vary from country to country. AID's Mali project, which also includes strengthening of the Mali Solar Energy Research Institute, is funded at about $5 million, with the equipment made part of the contractor's award.

Institution Building

Battelle's experience with the Korea Institute of Science & Technology (KIST) is typical of this sort of activity. Institution building remains a mission of AID. Such projects normally are multimillion dollar contracts, extend over five years, and require input from multiple contributors. Some in-country presence is essential, leading to long term assignment of at least one or two staff members for one or two years. Sort term visits to the host country by specialist contributors are also necessary, but these are limited to about 6 weeks maximum duration. Cooperative research between U.S. and host country staff provide a learning experience, and normally are selected to deal with real problems of importance to the host country.

This type of activity, with institutions centered on energy, can be expected to build through a number of sponsors. Institution-building on this topic is now taking place through AID in Mali, and can be expected to spread to Egypt and some Latin American countries over the next year.

Both DOE and the UNDP may substantially expand institution-building activities.

Applied R&D

U.S.-based applied R&D has been the weakest sector in this market. This is being corrected by strengthening the DOE program and by creation of new interagency programs to develop energy hardware.

For the main part, efforts to date have focused on photovoltaic systems, with the aim of helping to identif or create a foreign market for U.S.-made hardware. This approach has not been very popular with the LDCs, who see this particular technology as still too expensive. Also, the idea of new import dependency is not well received.

However, the idea of a range of new hardware items, such as wind machines, biogas-driven pumps, small water power systems and packaged cogeneration units of small scale has appeal. LDCs are willing to initially import some of this technology if it appears that in the longer view it can be adopted by indigenous industry and made in-country.

As noted in the discussion of sponsors, the delay of the Institute for Scientific and Technical Cooperation, which was to be the home of applied R&D, has put most of the needed work behind schedule. We will need to watch this market carefully to see how much of the work falls within DOE, how much within the AID Development Support Bureau, and whether any other unforeseen and radical shifts may be developing (e.g., into the NSF program).

Projects will include small scale gasification, and hardware or manufacturing technology problems associated with wind and water machines.

A number of related technologies involving energy use, such as newer trickle irrigation systems which conserve water as well as energy are receiving attention. Various types of solar dryers, improved cooking stoves and other such low technology approaches are being developed, primarily by smaller R&D organizations, universities and private voluntary organizations.

Technology Transfer

Technology transfer is most often thought of as a process whereby U.S.-developed knowhow is sold, licensed or given to other countries. Historically, the major activity of this sort has been the province of the multinational corporations, which have invested billions of dollars in developing countries and reaped billions in profits. The multinational corporation became a villain for some years, viewed as exploitive of cheap LDC labor and raw materials. This is changing as some positive experiences have developed with terms favorable to both LDCs and the multinational corporations.

However, the whole question of how and whether Battelle might serve multilateral corporations, who know the business of technology transfer but not the newer energy technologies, has not been investigated. An alternative way for Battelle to enter the multinational/LDC relationship is as a third party, examining the terms and conditions of agreements and the implications of policies with respect to foreign investment and ownership. The latter type of study is of interest to the UNDP and UNIDO.

More commonly, technology transfer from the sponsors I've described in this report consists of taking U.S. developments to the field, adapting them to local conditions, and working with counterpart host country technical and commercial people to evolve locally manufactured hardware. Technology transfer of this sort has occurred with some pyrolysis equipment in Africa under U.S. AID funding, in work done by Georgia Tech. So far, such work has been undertaken in conjunction with field demonstration projects or training, and not as a freestanding project. In part, this is the result of not having any clearly identified technology to transfer. Presumeably, this will change as alternative energy technologies evolve in the U.S.

Another form of technology transfer occurs between LDCs. Volunteers In Technical Assistance (VITA) is a private voluntary organization which collects examples of effective indigneous technology from around the world, decribing such hardware in sufficient detail to allow its replication elsewhere. The organization has operated in a low-key fashion for some years, but has recently received an AID contract for $10 million to increase their efforts, particularly with respect to energy-related hardware.

Field Projects for Demonstration

The most comprehensive field demonstration projects are funded by AID's regional bureaus. So far, these are directed to rural sector needs and to village-level systems. Each includes a variety of small scale hardware, utilizing wind, water, solar, biomass or other local renewable sources, with energy conversion to electricity, mechanical work or heat. Projects normally are funded for 5 years in the range of 4 to 6 million dollars. So far, commercially available hardware has been used exclusively. The objective of such work is to examine not only the economics of various approaches, but the suitability of various hardware to local operation and care conditions. The social aspects of the work include assessments of how these new technologies affect living conditions (e.g., health, nutrition, productivity, roles of women, etc.) Evaluation of cultural factors and institutional considerations is also part of the work.

Field demonstrations normally include elements of institution-building, training and technology transfer. The latter involves engineering and materials work to deal with hardware problems as these become clear under field conditions.

Information Exchange

Alternative Energy technology is a new category and a popular topic. Access to literature in this area and keeping track of international R&D and demonstration projects create a new need for collecting and accessing information.

So far these needs are met by the DOE-funded Solar Energy Information Data Bank program at SERI. This includes several elements, among them the International Projects Data Base, International Contacts Data Base and Manufacturers Data Base.

A comprehensive directory of biomass activity is issued by The Bio-Energy Council, partly funded by AID.

Mitre Corporation, under a contract with AID's Development Support Bureau Office of Energy, has been working up a scheme for computer storage and access of all alternative energy literature. The conceptualization of this information system has been done under a small ($40K) contract, and the result appears to be inappropriate for AID's needs.

There are openings here for information center development on specific energy sources and conversion methods, for developing ways of information storage and retrieval in ways suited to LDC conditions, and for developing information centers in LDCs as part of an institution-building effort.

Policy Development and Assessment

A great deal of activity falls into this category. The UNDP $235K multisectoral energy use study in Thailand is typical. The objective of the International Energy Development Program is to begin the process of national energy policy planning and assessment. The World Bank does similar types of projects. AID conducts work that is similar in kind, but with a generally narrower scope, examining options for rural sector and poor urban sector populations and limiting attention to low capital investment approaches.

These studies tend to be complex, involving several disciplines. Performers are few, as few institutions combine the requisite breadth of technical capability with sufficient strength in economics. Since upwards of 40 countries need to be studied over the next few years, this promises to be a large market.

Battelle has conducted many similar kinds of analyses in regional and national energy requirements, and in energy policy development with respect to building standards, appliances and other measures centered on conservation. Technoeconomic studies have also been done on newer technologies such as geothermal power and solar thermal electric power generating plants. The greatest amount of this work has been in the domestic program. The basic methodologies and teaming experiences apply to the foreign sector work as well, and some experiences have been gathered in this sector by a few staff at BNW and several contributors from BCL and Geneva.

POTENTIAL ROLES FOR BATTELLE

Each of the types of projects summarized in the previous section carries a plurality of sponsoring organization possibilities, and sufficient funding exists for each to justify all as legitimate target markets. Strengths and interests across the Institute vary on these topics.

Given the foregoing information in previous sections of the report, the readers no doubt will have their own ideas about how this market might mesh with their own interests. However, I will summarize some of the possibilities as I see them now.

1. Resource Assessment and Planning Studies, which call for multidisciplinary talents, constitute a large market wherein the private sector competition is thin. These include collection and analysis of data on wind, hydrology, biomass distribution, insolation and mineral resources. Collection of data and design of models to handle input/output data on sectors of LDC economies is also necessary. Technical assessment of practices in mining, manufacturing, transportation and other technically oriented matters is also necessary. The FY 81 market size for this is on the order of $60-80 million, for the main part through IBRD and UNDP funding, with lesser amounts through DOE and AID.

2. Technical Services and Assistance on Specific Technologies can be provided to a number of sponsors, and can be established in a variety of ways. Particular strengths in resource assessment, noted above, may be provided as elements in whole country planning studies conducted by others. Advice on specific technologies and methodologies can be provided under Basic Ordering Agreement or Indefinite Quantity Contract arrangements. For example, AID has a $2 million contract with NASA-Lewis, arranged at the suggestion of DOE, to advise on photovoltaic technology and refine systems for LDC use. Similar arrangements covering established Battelle strengths might include biomass production and coversion processes, wind energy regional assessment techniques, wind energy system siting, use of remote sensing data for resource assessment, hydrology studies and ecological impact assessments.

3. Project Management roles like those in the DOE domestic program might be evolved for AID and other sponsors. A prime possibility is coordination and management of international biomass research, which would complement the evolving domestic lead and benefit both sponsors. Additional 1831 funding, complementing the DOE support, could be used to expand staff and equipment.

4. Management of Country-Scale Field Demonstration Projects which involve input from several disciplines is a strong market for us, with comparatively little competition. Projects are being developed by AID Regional Bureaus. Projects of smaller scope take place under the DOE bilateral energy agreement program. These projects range in value from the $4-6 million AID country programs to the $14 million Saudi Arabia solar village project funded by DOE.

   Projects of this sort do call for long term field assignment, as has been done in the past with KIST, Iranian planning and studies in Thailand.

5. Institution-building, of the sort exemplified by the KIST project and to a lesser degree by more recent activities in Taiwan, Kuwait and Saudi Arabia is a marketable Battelle strength.

   One of the principal findings of the DOE International Energy Development Program is that countries by and large lack the institutional strength to assess, plan and develop energy sources and implement their plans.

   AID's FY 81 budget includes about $25 million for institution-building. This sort of activity is a major objective of the new Special UN Fund for Science and Technology as well, but may not get strongly underway until FY 82. DOE is examining institution-building for energy as a possible mission, but has no clearly identified funds for this in FY 81. The World Bank and its LDC-oriented affiliate, the International Development Association, provide loans and credits for institution-development.

   The creation of a Peruvian Energy institute is a current topic under discussion with DOE's International Affairs Division. Principal competition in this area is the Solar Energy Research Institute (SERI), which is pressing the idea of creating SERI-like institutions around the world with DOE support. SERI is in fact doing this in Mali under AID sponsorship as part of a country program on alternative energy.

6. Applied R&D may be done on a number of topics, such as biomass production, biomass conversion processes, smaller cogeneration systems, fuel substitution impacts on design and materials in diesel and spark-ignition engines, development of efficient pumps, methods for use of marginal lands and a range of adaptation and updating work on older, intermediate scale apparatus for power generation, shaft horsepower or heat. Optimization of smaller scale manufacturing processes for products such as cement, fertilizer, charcoal and development of techniques for water treatment and sewage handling form related topics.

   To an increasing degree, such developments will be funded by collaborative projects between DOE/AID/DOC and by an increasing recognition of the similarities of technical approaches in the domestic farm sector program and the village-scale energy needs in LDCs.

   Domestically, through DOE, many of the challenges (such as fuel substitution impacts on engine service and longevity requirements) have not been monopolized by any of the national labs. Some existing leads, such as the Rocky Flats small wind machine testing program, have limited scope for actually refining hardware. There is accordingly some chance of using the international program as a way to capture some elements of hardware development work which can subsequently be done for DOE as well.

MARKET DEVELOPMENT

Looking back over my recommendations from August, 1979, I think a number of the requisite steps have been taken or are in the process of consideration. Reiterating these briefly below:

1. The LDC energy business is percieved as a market (although not uniformly or clearly across all components), and some focus has now been established through my office in Energy Systems with baseline support.

2. We have a good start on an inventory of Institutional capabilities and staff, with about 220 people identified across the Institute and a number of these (about 20%) having relevant international experience. Cooperation and interest are increasing across the organization.

3. A new HARC center is being established in D.C. in January, named the Center for International Development. This at least gives some identity to Battelle's interest in international development. The new center's focus is health, population and nutrition, at least initially.

4. We have had some contact with Argonne and with SERI at intervals over the last year or so, and have some evolving relationships which should begin to pay off.

5. Some progress has been made on approaches to AID and DOE illustrating Battelle's strengths and interest in international work. More needs to be done within the IDCA/AID organization, particularly in the Regional Bureaus, but we now have sufficient information pulled together to do this.

6. Profit-taking modes of operation were considered briefly in examining an AID-suppported Haitian forestry corporation possibility, but this particular opportunity was rejected. This type of activity is more properly an SAI one, and might be considered again later.

7. The tactic of using PNL's status as a national laboratory as an entry to DOE work on international energy assessment and planning has been implemented and is under discussion.

8. Unsolicitied proposals have been developed and submitted to AID, and two small, sole-source awards have been made for biomass gasification.

9. The DOE-administered joint U.S.-Japan energy agreement is not finalized. We will continue to follow this, as it is potentially a large opportunity.

10. Selection of countries for emphasis has not been done. However, the idea of this approach of targeting a few countries for project development work has been accepted by Battelle International Organization, and is under discussion within Battelle.

Mechanisms to share information between components are evolving within BNW through an ad hoc LDC Alternative Energy Working Group. BIO has now recognized the BNW initiative in this activity, and planned interactions are part of BIO's strategies.

The underlying strategy of market development so far has been to identify conspicuous Battelle strengths, many of which have come from the DOE domestic program, and to cast these in terms of relevance to foreign applications and needs.

This has been done by discussions with other Battelle staff, by reviews of literature and news items, through contacts with major sponsors and by my own familiarity with LDC conditions. The latter is due to some eight years of professional activity in this arena and to field visits and work in eight countries, mainly in South and Southeast Asia.

Market development is an evolutionary process, and, particularly where an essentially new market is the target, limited leverage can be gotten from existing projects. We foresee a continuation of the market development activities that have marked the last several months. These are:

1. Continuing contact with AID Office of Energy and USDA staff to build on our early penetration of their biomass program.

2. Submission of capabilities information and discussions with Region Bureau staff of AID to put ourselves in line for country-wide alternative energy programs expected in FY 81.

3. Establishing contacts in AID Regional Bureaus to assure capture of one or more indefinite quantity contracts in the Spring of CY 81.

4. Pursuit of specific hardware development projects through a new AID/DOE/DOC applied R&D program ($10.5 million market) through existing contacts. Initially, we will emphasize the systems approach to a close-coupled gasifier with an internal combustion water pump. In this early stage, it is not clear whether such work will eventuate through DOE or AID channels.

5. Continued refinements in approaches to institution-building will be made, fleshing out the BMI capabilities and interests, attempting not only to support DOE International Division's interest in this mission, but also to open discussions with UNDP, IBRD and AID sponsors of such work.

6. Feedback from DOE on revised approaches to international energy assessment and planning programs will be used to create a restructured approach to this. The market includes DOE, but a substantial market also exists at the World Bank and the UNDP.

   We will need to develop some new capabilities information on approaches to LDC econometric modeling and forecasting techniques, adapting background materials used in the U.S. and European markets.

7. Conduct of international meetings and workshops is surfacing as an interest of both AID and DOE's International Affairs Division. We need to assemble a prospectus which combines the laboratories' experience and specialized technical knowledge with the international conference organization and management experiences of HARC and BSSP.

8. Identification of target countries for proactive Battelle project development activities needs attention, and we expect to work with BIO on this question. Also, we expect to use BIO support for some exploratory field project development activities.

9. The process of internal education about this market and establishing more precision about the interests of contributors are important next steps in building our ability to respond to opportunities and in identifying special interests across the organization to take to sponsors.

Beginning this fiscal year, we have established a combination of 1830 and 1831 baseline support funds to cover 1/2 time for me and 1/2 time for an assistant. This is a major commitment, but we believe it is justified by the market size and by the congruence of a good business opportunity with strategic objectives of the Institute.

Using the topic of energy, where we have recognized excellence, we look to this market as a way of establishing a Battelle presence in LDCs through sponsored research. This presence can and should lead to other contract R&D opportunties, which we would not ordinarily receive due to the high cost of foreign PD activity.

The balance of this program, as it begins, will doubtless be skewed by the nature of initial sales. It is our intention, however, to develop a mature and stable business of several million dollars per year, with benefits spread across most of the organizational components. Considering the current size and growth rate of the target market, capture of a percent or two should accomplish this objective.

APPENDIX

GLOSSARY OF ACRONYMS

ADB - Asian Development Bank

AFDB - African Development Bank

AID - Agency for International Development

ANL - Argonne National Laboratory

AT - Appropriate Technology - an ill-defined but prevalent term, generally taken to mean low capital investment technology of simple design

ATI - Appropriate Technology International - A govt corporation to foster the development of appropriate technology for LDC use.

CDB - Carribean Development Bank

DOC - Department of Commerce

DSB - Development Support Bureau - technical support branch within AID

EEC - European Economic Community

ESF - Economic Support Fund - portions of foreign assistance appropriations used for security, peace-keeping operations and balance of payments emergencies.

FAO - Food & Agriculture Organization of the United Nations

IAEA - International Atomic Energy Agency

IBRD - International Bank for Reconstruction & Development (The World Bank)

IDA - International Development Association - part of World Bank which provides interest-free credits (loans) to lower income LDCs.

IDB - Inter-American Development Bank - part of the World Bank group

IDCA - International Development Cooperation Agency - new federal agency responsible for developmental assistance, replacing State in this role.

IEA - International Energy Agency - Cooperative of OECD nations to set energy production goals, stabilize supplies and cooperate in development of newer energy technology.

IEDP - International Energy Development Program - Energy assessment & planning studies for signatories of the nuclear non-proliferation treaty, executed by DOE.

IMF - International Monetary Fund

ISTC - Institute for Scientific & Technical Cooperation - Planned R&D organization within IDCA, not approved by Congress yet.

ITDG - Intermediate Technology Development Group - British, small-scale technology similar to that used in early portions of Western industrialization, seen as appropriate to similar needs in LDCs.

LAC - Latin American & the Carribean, a Regional Burean within AID.

LDC - Less Developed Country - Pre-industrial economies, dominated by subsistence agriculture or export of raw materials for income.

ME - Middle East & Europe - an AID Regional Bureau.

NAS - National Academy of Sciency

NSF - National Science Foundation

OECD - Organization for Economic Cooperation and Development - Industrialized, oil-importing nations (U.S., Canada, Western Europe, Japan).

OMB - Office of Management & Budget - Agency for Federal government on effectiveness of executive agencies and interdepartmental cooperation.

OPIC - Overseas Private Investment Cooperation - Investment insurance operation part of IDCA to encourage foreign investment by U.S. corporations.

PL 480 - Public 480 - Food for Peace legislation covering grain sales & gifts.

PPC - Policy & Planning Coordination - bureau within AID.

SEED - Science & Engineering in Economic Development - An AID technical exchange program executed by NSF.

SERI - Solar Energy Research Institute - lead national lab for solar energy research.

UNCNRSE - United Nations Conference on New and Renewable Sources of Energy - to be held in Nairobi in 1981.

UNDP - United Nations Development Program - Focusing on developmental assistance within the U.N.

UNEP - United Nations Environment Program.

UNIDO - United Nations Industrial Development Organization.

SPONSOR CONTACTS AND INFORMATION SOURCES

Michael D. Benge - AID Asian Bureau
Manfred Beotgen - IBRD
Norman Brown - AID Asia
Russell Ferguson - IDB
Murray Goldberg - SERI International Division
Lloyd Herwig - DOE Office of Scientific & International Programs
Gerald Hickey - AID Asia
James Horgan - Near East Development Group, Inc.
James Howe - Overseas Development Council (now at SERI)
David P. Hughart - IBRD
Alan Jacobs - AID/DSB, Office of Energy
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Steven Klein - AID/PPC
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James Stromayer - Department of State
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