GLOBAL ENVIRONMENT FACILITY

Joel:
Project-files
CC

MOHAMED T. EL-ASHRY
CHIEF EXECUTIVE OFFICER AND CHAIRMAN

June 13, 1997

Dear Council Member:

UNDP as the Implementing Agency for *Jordan: Reduction of Methane Emission and Utilization of Municipal Waste for Energy in Amman Project,* has submitted the attached proposed project document for CEO endorsement prior to final approval of the project document in accordance with UNDP procedures.

Over the next four weeks, the Secretariat will be reviewing the project document to ascertain that it is consistent with the proposal included in the work program approved by the Council in April 1996, and with GEF policies and procedures. The Secretariat will also ascertain whether the proposed level of GEF financing is appropriate in light of the project's objectives.

If by July 11, 1997, I have not received requests from at least four Council Members to have the proposed project reviewed at a Council meeting because in the Member's view the project is not consistent with the Instrument or GEF policies and procedures, I will complete the Secretariat's assessment with a view to endorsing the proposed project document.

Sincerely,

Ian Johnson

for Mohamed T. El-Ashry
Chief Executive Officer and
Chairman

cc: Alternates, Implementing Agencies, STAP

GEF SECRETARIAT, 1818 H STREET NW, WASHINGTON, DC 20433 USA
TELEPHONE (202) 473 3202 FAX (202) 522 3240/3245

United Nations Development Programme

GLOBAL ENVIRONMENT FACILITY (GEF)

To: Dr. Mohamed El-Ashry
CEO and Chairman
GEF Secretariat

Date: 6 May 1997

Copy: Dr. Dilip Ahuja
Climate Change Specialist
GEF Secretariat

From: Rafael Asenjo
Executive Coordinator

Subject: **Jordan: Reduction of Methane Emissions and Utilization of Municipal Wastes for Energy in Amman**

Enclosed herewith is a copy of the UNDP/GEF project document for Jordan: "Reduction of Methane Emissions and Utilization of Municipal Wastes for Energy in Amman" (JOR/96/G31).

You will recall that this project was cleared by the GEFOP of 14 December 1994, but held in abeyance by the CEO until the completion of the Operational Strategy and thus submitted to and approved by the Executive Council in May 1996.

I am, therefore, forwarding the project document in accordance with document GEF/C.4/7 (Project Cycle) requesting the GEF and Council Members' clearance prior to final approval by the Implementing Agency.

Please do not hesitate to contact me should you require any clarification on the project document.

Many thanks in advance.

Street Address: 304 East 45th Street, 10th Floor, New York, N.Y. 10017
Tel: (212) 906-5044, Fax: (212) 906-6998

PROJECT OF THE GOVERNMENT OF JORDAN
GLOBAL ENVIRONMENT FACILITY

PROJECT DOCUMENT

Number & Title: **JOR/96/G31/A/1G/99** - Jordan: Reduction of Methane Emissions and Utilization of Municipal Waste for Energy in Amman.

UNDP financing	
UNDP/GEF	USD 2,500,000
DANIDA cofinancing	USD 1,500,000

Duration: Three (3) years
Project site: Amman, JORDAN
ACC/UNPD sector: 035 Energy
Govt. sector: Renewable Energy,
Government implementing agencies:
Ministry of Planning,
Municipality of Amman
Jordan Electricity Authority

Executing Agency: Government of Jordan through the Ministry of Planning
Estimated starting date: September 1997
Government input: USD 1,319,000
GEF input: USD 2,500,000
UNDP(DANIDA) input: USD 1,500,000
GEF PRIF preparatory funds USD 240,000

Brief description: The goal of the project is to reduce emissions of greenhouse gases in Jordan by substituting fossil fuels with bioenergy (methane gas and electricity), produced from anaerobic digestion of industrial and municipal waste in Amman. Additional greenhouse gas reduction will be achieved by reducing the uncontrolled release of methane from improperly disposed organic waste in a large landfill. The project's main activities include a combination of a landfill operation and a biogas plant. The required institutional, management, and social structures to sustain the project will be developed through technological exchanges and training programs. Inputs include 72 person months from UNDP/GEF and 246 person months from the Government, as well as equipment and training. A prime activity of the upgraded institutions will be the capability to generate replicable projects in Jordan and other countries in the Middle East to demonstrate the environmental and energy related benefits from using municipal and industrial organic waste in energy production. The proposed plant will be able to produce 1 MW of electricity based on methane from the landfill and the biogas plant. The project combines methane emission reduction and thus GHG reduction, with production of electricity, thus helping to reduce Jordan's dependency on oil.

On behalf of:	Signature	Date	Name/Title (please type)
The Government:			
UNDP:			

ACRONYMS

AD	Administrative Director
CH4	Methane
CO2	Carbon Dioxide
DANIDA	Danish International Development Assistance
EU	European Union
GAM	Greater Amman Municipality
GCEP	General Co-operation for Environment Protection
GEF	Global Environment Facility
GHG	Greenhouse Gases
JBO	Jordan Biogas Based Electric Power Generating Organization
JEA	Jordan Electricity Authority
JES	Jordan Environment Society
JICA	Japanese International Co-operation Agency
MEMR	Ministry of Energy and Mineral Resources
MP	Ministry of Planning
MSW	Municipal Solid Waste
NES	National Environment Strategy
NGO	Non-Governmental Organization
QAF	Queen Alia Fund
PRIF	Pre Investment Feasibility Study
RSS	Royal Scientific Society
SCC	Special Consultative Committee
SPEP	Society for the Prevention of Environment Pollution
UJ	University of Jordan
UNDP	United Nations Development Programme
USAID	United States Agency for International Development

TABLE OF CONTENTS

A. CONTEXT

1. DESCRIPTION OF SUBSECTOR

The Government of Jordan has prepared and endorsed a National Environmental Strategy in which the energy sector figures prominently. The expected annual growth rate in energy demand is 6%, and the Government is seeking to meet part of the demand by means of the renewable energy sector. The Government has created a separate department in the Ministry of Energy and Mineral Resources (Renewable Energy Department) to promote the use of alternative energy and energy conservation. The private sector is encouraged to participate in the development and implementation of these alternative technologies.

The Greater Amman Municipality (GAM) is responsible for municipal affairs in Amman and its suburbs. Amman has a population of over one million and, with its nearby suburbs, the population is around 1.6 million representing more than one third of the population of Jordan of 4.4 million in 1996. The city and its population are growing rapidly at a rate of almost 5% annually, which is caused by a high birth rate of 3.0 - 3.5% and migration to the city.

Zarqa, including its suburbs to the north-east of Amman, has a population of half a million and is the second largest city in the country. It is also growing rapidly due to urbanization and high population growth. The municipalities of Amman and Zarqa share the same landfill for dumping of solid municipal waste (MSW). This is an old phosphate mine in the Ruseifeh area between the two cities. The Public Cleansing Department in the Greater Amman Municipality is responsible for collecting waste from the city of Amman and dumping it into this landfill. The annual collection amounts to 0.6 million tones of MSW (1600 tones daily). By the year 2000 waste collection in the two urban areas would exceed 2300 tones daily, rendering it a sizable MSW collecting system by world standards.

Biogas from landfills has been used for several decades in most industrialized countries. Using biogas from biogas plants is also an efficient technology, a well demonstrated and cost-effective method of disposing of organic waste and of producing electricity, fuels and fertilizers without releasing greenhouse gases (GHG) into the atmosphere. Using biogas technology, large quantities of organic waste can be almost totally converted into energy (for electricity production, heating, or truck and automobile methane fuel) and organic fertilizer.

This project will facilitate the construction of a combined landfill operation and a biogas plant in Amman and create the educational, management and social structure for replicable projects in Jordan and other Middle East countries. The project seeks to demonstrate, first within the Jordanian context, the environmental and energy-producing benefits from using municipal and industrial organic waste. A combined landfill operation and biogas plant does not exist in any other developing country. The biogas plant will have a capacity for treatment of about 60 tones of organic waste per day, or about 3 percent of the daily waste generated in the capital city. The project combines methane emission reduction with new ways of producing electricity and fertilizer for surrounding farms, thus helping to reduce Jordan's dependency on oil imports. The electricity generating potential of the portion of Jordan's organic waste which was evaluated in a study funded by the GEF's Pre-Investment Facility ("PRIF") is equivalent to approximately 28 MW. (See also the PRIF Study: "Environment and use of methane from municipal waste, UNDP 1993").

It is anticipated that this project will be the first in a series of similar projects constructed throughout Jordan and the Middle East. By demonstrating that it is not only technically feasible but economically viable, within the Middle East context to use urban organic waste for biogas production, and by simultaneously cultivating the indigenous interest and capacity for creation of such a facility, this project can lead to the construction of additional plants at reduced cost with resulting energy and environmental benefits.

The potential for replication of this technology in Jordan is considered extremely advantageous. In the case of the initial installation of the first biogas plant, the training and familiarization associated with its establishment, means that there are a number of barriers associated with this project, which brings the overall price to 5.6 per kWh for the initial power production from the biogas plant. However, it is calculated that future installations will be considerably cheaper, both as far as installation and labor is concerned and that future plants will be able to produce power at rates competitive with the conventional carbon-based power production. Moreover, the present electricity price of $4.7 c per kWh is likely to increase, as established LRMC curves indicate a steady rise.

Once constructed, the combined biogas plant is designed to be economically viable and further, to generate a profit by producing electricity and fertilizer with commercial value. Income from the sale of these products will be used to cover all operating costs of the plant and to promote further biogas plants, as well as training in and dissemination of biogas technology in Jordan.

Jordan's national power utility, the Jordan Electricity Authority (JEA), has already agreed to finance the connection of the biogas plant to the public grid and to pay market rates for the biogas generated electricity.

The annual profit of approx. USD 175,000 estimated generated from the plant will be used to build other equally profitable biogas plants over the expected lifetime of the pilot biogas plant of 20 years.

The PRIF Study showed that sufficient quantities and qualities of readily available organic waste exist in Jordan for construction of several financially viable plants.

The amount of methane presently emitted from the MSW of the GAM is about 22,000 tones per year, as only half of the waste is digested anaerobically in an open landfill. In 1995, this was equivalent to CO_2 equivalent of almost 1/2 million tone of CO_2 per year which would continue to increase by 4-5% annually. This will be reduced by the proposed project.

The project investment from GEF and DANIDA will be USD 4 million; this includes a capacity building and training component of USD 0.8 million. The capacity building program will ensure the basis for replicable projects in addition to providing actual training of key personnel.

After this project has performed the necessary barrier removal, the investment required for a full fledged program for utilizing all the waste for gas production (during an investment phase) will be approximately USD 10 million. This investment would lead to an annual reduction of CO_2 equivalent gases of 0.5 million tones. The cost of curbing one tone of CO_2 equivalent source is thus USD 20. Over an expected lifetime of 20 years, the discounted cost of curbing one tone emitted from a CO_2 equivalent source could be as low as USD 1 per tone, which is a very high rate of return on such an investment. In spite of the anticipated financial viability of such a plant, it is clear that multinational, regional and national banks are not likely to grant loans for such an enterprise until its feasibility is fully demonstrated in the Middle East. The present project sets out to demonstrate this viability.

The educational level is high in Jordan compared with Middle East standards and Jordanian experience spans most economic and technical branches. Waste collection, for instance, is highly organized and the operation of dumping sites is carried out on a professional basis. Because of the human resources and organization level, Jordan is an excellent choice for implementation of biogas

and landfill gas technology within the region. During the PRIF Study, the patterns necessary for implementation and development of biogas and landfill gas technology in Amman have been identified and a training program for technology transfer has been defined.

In addition to the Municipality of Amman, the Jordan Electricity Authority will play an active role in the project, while the Ministry of Energy and Mineral Resources and Jordan Environment Society and the Queen Alia Fund will be responsible for dissemination of the results collected during the project and public awareness and outreach.

In 1995 the Government of Jordan enacted a new environmental law which regulates environmental activities in the country. Jordan further established a General Corporation for the Environment (GCEP). This Corporation has gradually commenced to assume its responsibilities under the Environment Law.

The University of Jordan is most suitable for scientific back-up and support of the project. By securing proper training and transfer of technology in connection with the project, the project biogas plant will act as a center for promoting this technology in Jordan and the Middle East. This will be further enhanced by Jordan's active cooperation with its neighboring countries.

While biogas production on a large scale is innovative within the Middle East, well-running large to medium-sized industrial projects have been constructed and are operating well in Jordan. Construction and operation of a large-scale biogas plant will not present major obstacles in view of the high standard of education and management in the country. Furthermore, the technology has been successfully demonstrated over the past decade in northern Europe, particularly in Denmark's biogas plants, which treat municipal and industrial organic waste.

The present combined landfill-biogas reactor technology option is selected on the basis of the Feasibility Study which was carried out with PRIF funding. It should be recalled that Jordan has extremely scarce water resources, and landfills are therefore generally considered undesirable as they tend to cause leaching, infiltration and pollution of the scarce groundwater resources. A "landfill-alone" option is therefore not considered a viable demonstration technology in the Middle Eastern context, where conservation of scarce water resources continues to be of the highest national priority. To the contrary, it is a major environmental priority to ensure a reduction of leaching into the groundwater through limiting landfill growth and expansion. By introducing the biogas reactor technology in the Middle East, organic waste will be directed to the biogas reactor and will therefore not be destined for the landfill. Moreover, in countries afflicted by soil erosion,

land degradation and marginal farming, the by-product (fertilizer) is likely to become an extremely useful product, once introduced to the market. Finally, while the "landfill alone" option would essentially only be a viable option for a finite period of years until all methane has been extracted from the landfill, the biogas reactor offers a more longer-term and sustainable solution. Based on the above, therefore, the combined landfill and biogas reactor solution was chosen.

2. HOST COUNTRY STRATEGY

Jordan is not only being confronted by a shortage in indigenous energy resources, but is also likely to face a more severe shortage in the most basic of natural resources, namely water.
At the national level, there has therefore been a growing recognition that economic development, and the health and the welfare of the population is closely linked to the proper management of natural resources, especially water. This is reflected in two major initiatives, that could change the character of environment management in Jordan, namely the National Environment Strategy and the development of the comprehensive environmental law. The National Environment Strategy was officially approved and published in 1991. The Strategy provides important information and makes key recommendations to address vital environmental problems in Jordan such as water shortages, desertification, ground water pollution and others.

Addressing the shortage of indigenous energy resources has received a great deal of emphasis by the Government of Jordan. Foremost attention has been given to the development of local energy sources utilizing indigenous resources. This has become one of the central pillars of the Government's energy plan and development strategy. The Jordan Electric Authority (JEA) is aiming at the utilization of renewable energy resources for the meeting the growing demand for power in Jordan. The utilization of Municipal Solid Waste (MSW) in energy supply and/or in power production, will therefore serve development strategies of both central Government, local Government (Greater Amman Municipality) and the JEA.

In response to the Government's development strategy, the proposed project has two purposes. Firstly, it will enhance the efficient and clean way in which MSW is collected in the GAM and help to curb hazardous and dangerous emissions and smells which are originating from the present landfill and the fires which suddenly erupt in the present landfill due to the release of methane gas. Such gas releases can also cause dangerous explosions in certain cases. Secondly, the project will open the way for the beneficial utilization of MSW for the local production of energy in the country. Jordan is short of indigenous resources of energy and has to depend on imports to satisfy

its growing needs. The project would serve Jordan's strategy in providing a local renewable source of energy, however modest this may seem at the beginning.

Through its emphasis on environmental cleanliness and useful utilization of waste to produce a renewable energy source, the project serves the sustainable development of Jordan. It will also help Jordan acquire modern technologies and act as a demonstration center for these in the Middle East.

3. PRIOR OR ONGOING ASSISTANCE

Jordan's energy sector has for many years adopted an open door and active dialogue with other developmental and donor agencies. In addition to UNDP, this includes the World Bank, USAID, GTZ, EU and many other technical assistance agencies. Such assistance has involved all sectors of energy: electricity, renewable energy, oil and gas development. It has also included managerial training, demonstration projects and provision of software and data systems.

UNDP has initiated technical assistance projects in the energy sector in Jordan, the most recent of which is the establishment of a data bank for electricity and energy information. This project is presently under implementation. During the past few years, UNDP has undertaken other projects aimed at strengthening Jordan's energy sector in the activities of energy planning, demand forecasting and oil and gas production sharing agreements.

The World Bank was particularly active in capacity building in the energy sector, providing technical assistance for restructuring and improving the management of this sector. A major share of technical assistance went into the electricity subsector where the World Bank assisted in initiating demand side management activities and also in building a small demonstration renewable energy wind farm.

The Jordan energy sector enjoys good relations with the EU and USAID as well as with many other European countries and Japan through bilateral assistance agreements. Through this assistance, the energy sector in Jordan has been able to build energy consumer centers and a electric power training center, now acting as a training center for the region. Technical assistance from Germany greatly assisted in developing the utilization of solar energy and other renewables in Jordan.

This technical assistance has meant that Jordan's energy sector is well managed and better planned than most other energy sectors in the region. Jordan therefore acts as a demonstration and training ground for other countries in the region in energy matters.

4. INSTITUTIONAL FRAMEWORK

The Ministry of Planning has been nominated to have the overall responsibility for all GEF projects in Jordan and will act as coordinator for this nationally executed project.

Like municipalities of other large cities, the Greater Amman Municipality (GAM) runs a number of services for the population. Waste collection in Amman is handled very efficiently by GAM, and collecting the amount and types of waste required as input for the biogas plant will pose no problems to the GAM. The landfill operation at the Ruseifah site is organized by GAM, and the technical aspects of organizing the drilling required to utilize the methane from the landfill can be carried out by GAM as well.

Overall responsibility for the management of the energy sector rests with the Ministry of Energy and Mineral Resources (MEMR). Energy planning is undertaken in coordination with the Ministry of Planning. The electricity subsector is managed by the Jordan Electrical Authority (JEA) and that of the oil and gas subsector by the Natural Resources Authority, both of which are semi-autonomous institutions. The Minister of Energy is the Chairman and President of these two institutions, respectively. Besides the MEMR and JEA, renewable energy activities are carried out by other institutions, the foremost of which is the Royal Scientific Society (RSS), which is particularly involved in solar energy and other forms of renewables.

The JEA has a large amount of experience and capability in the operation of gas turbines and diesel engines similar to these to be utilized in the present project. JEA has been operating gas turbines firing diesel oil and natural gas for more than fifteen years and gained a lot of experience in operating and maintaining such engines. The engines provided under this project, the operation of which will be en-trusted to JEA, will not post any technical problems to the capable staff of the Authority.

A joint venture between the JEA and the GAM will be established. This joint venture, the Jordanian Biogas Based Electric Power Generating Organization (JBO) will be the institution

responsible for the actual construction and day to day operation of the combined biogas and landfill plant. A copy of the draft agreement between the JEA and the GAM is given in Annex VI.

B. PROJECT JUSTIFICATION

1. PROBLEM TO BE ADDRESSED; THE PRESENT SITUATION

Jordan is a developing nation with an average per capita income in 1995 of about USD 1600. Jordan has significant agricultural activity and moderate industrialization. Due to lack of local energy sources, Jordan is totally reliant on energy imports. Furthermore, the limited resources of fresh water are vulnerable when faced with the threat of pollution such as the one posed by waste deposition.

City	Population	Dump site		
	million	Name	Capacity	Type
Amman (municipal)	1.10	Ruseifeh	1600 t/day	landfill
Amman (with suburbs)	1.60	Ruseifeh		
Zarqa (municipal)	0.40	Ruseifeh		
Zarqa (with suburbs)	0.60	Ruseifeh		
Irbid (municipal)	0.24	Akeider	700 t/day	Open air
Irbid (with suburbs)	0.80	Akeider		
Ramtha	0.05	Akeider		
Mafraq	0.05		Not available	Open air
Salt	0.16	Al-Hamra	300 t/day	Landfill
Madaba	0.07	Madaba	Not available	Open air
Karak (with suburbs)	0.06	Karak	Not available	Open air
Maan	0.04	Al-jafer	Not available	Open air
Aqaba	0.07	Aqaba	Not available	Open air

Table 1 List of main cities in Jordan with population figures, landfill sites/types and waste reception capacities.

In terms of quantity per capita and constituents, the waste generated in Jordan is comparable to that of most semi-industrialized nations. The total generation of waste in Jordan is estimated at 8000 tones per day of which approx. 3200 tones/day is estimated as being household waste and the remainder industrial and agricultural waste. The distinction between industrial and household waste quantities is difficult due to the lack of discrimination between non-hazardous (mostly organic, paper and plastic) industrial waste and household waste during waste collection. Table 1 presents a list of the main cities in Jordan, their landfill sites and reception capacities.

Town/area	Jordan total	Greater Amman & Zarqa	Irbid	Jordan Valley	Dhleil	Others
Population	4.4m	2.3m	700000			1.4m
Municipal waste	1.61m	770,000	280,000	small	small	560,000
Organic fraction	1,050,000	500,000	185,000	small	small	365,000
Included in the municipal fraction:						
Slaughterhouse	17,660	9,636	3,212	small	4,015	797
Vegetable market	12,045	7,227	2,409	2,409		0
Hotels	12,045	10,846				1,200
Restaurants	48,180	32,120	4,015			12,045
Organic industrial and agricultural waste:						0
Tanneries	410	410				0
Eating oil refineries	1,200	1,200				0
Sesame oil	4,820	3,200	400			1,220
Meat processing	400	400				0
Canneries	13,300	400		12,400	120	380
Dairies	3,600	400			400	2,800
Vegetable farms	230,000	30,000	6,300	161,000		32,700
Olive-oil mills	7,700		6,300			1,400
Chicken manure	385,000	121,000	69,000	4,400		190,600
Cow manure	880,000				145,000	735,000
Total organic:	2,576,430	657,010	267,000	177,800	145,520	1,329,100

Table 2 Annual generation of organic waste in larger towns/areas of Jordan. All values in tones/year. 1995 estimates.

In this project the focus is on organic matter waste generation. Table 2 presents a list of waste by source.

In addition to the figures in table 2, an annual amount of 1,83 million m^3 of septic and pre-sedimentation sewage sludge from treatment of 43.8 million m^3 of sewage water is generated in the Greater Amman area.

Altogether, the potential annual amount of sewage sludge and septic generated in Amman, is estimated at 84,700 tones of dry matter.

The major part of the population lives in the capital, Amman, which has about 1.6 million inhabitants, representing more than one third of the population of Jordan of 4.4 million in 1995. The neighboring city, Zarqa, has the second largest population of 700,000.

The municipalities of Amman and Zarqa share the same landfill for dumping the solid municipal waste. The Public Cleansing Department in the Greater Amman Municipality (GAM) is responsible for the collection of waste from the city of Amman and disposing of it in the landfill. This site, the Ruseifah Landfill receives 1,500 to 2,200 tones of waste per day, amounting to 600,000 tones of MSW annually, and is by far the largest and main landfill site in Jordan.

Deposition of waste in landfills suffers from the shortcoming of causing severe environmental problems, i.e. emission of greenhouse gases (methane and carbon dioxide) and other substances, toxic residuals, potential contamination of ground water, pollution of the waterways, odour nuisances, etc.

The Ruseifah Landfill is presently a major emitter of greenhouse gases. More than 40,000 tones of methane is generated annually at the landfill site and released into the atmosphere, due to anaerobic digestion of the organic waste fraction, which makes up approximately 65% of the waste received. Methane is a highly concentrated greenhouse gas with a global warming effect equal to 21 times that of CO_2. Therefore the present equivalent emissions of CO_2 amount to over one million tones.

The two main cities, Amman and Zarqa, have a well-developed and efficient waste collection system with large containers for collection of household waste located at various places in the city and separate collection systems for institutions, hotels and small-scale industries, etc. To collect the waste and transport it into the landfill site, the city operates a fleet of 100 vehicles, each with a capacity of approximately 12 tones, and a staff of 200. Waste is collected daily from street containers and transported to the dumping landfill site. At the landfill, the waste received is compacted and covered with soil.

A system for differentiating between different sources and industrial waste is not in place within the same collection system. Hazardous and chemical industrial waste, however, is handled in a separate system by a specified procedure related to the nature of this type of waste. Other items

that are handled separately are building material, bulky items such as refrigerators and furniture, which are transported by the owners to a specified site different from the landfill.

Liquid waste generated by industry and food processing entities (slaughterhouses) is pre-treated to meet health regulations and then disposed of into the wastewater sewage system.
Apart from the exceptions discussed above, all waste without distinction goes into the containers. No policy or practice exists for waste segregation. Containers normally contain a mix of waste, even at industrial sites.

The total area of the Ruseifah Landfill is 700,000 square meters with the first stage occupying 200,000 square meters. The first stage is expected to last another 2-3 years before exhausting the allocated space. The entire landfill is expected to meet disposal needs for another decade only, if no major waste processing projects are established.

The Arab region is one of the most rapidly growing regions with regard to population and urbanization. The city of Cairo has a population exceeding 12 million, and the cities of Damascus and Baghdad each claim at least 3 million. By the end of this century the Arab region will contain many mega-cities. Such urban expansion is creating daily problems in handling and disposing of increasing amounts of MSW. Furthermore, it creates serious sources of globally detrimental emissions.

The limited landfills are forcing these cities to contemplate many projects for handling and treating MSW not all of which are environmentally clean. Production of compost has been attempted in some of these cities with environmentally detrimental results. Other cities, being unable to handle the rapidly increasing flow of MSW, are allowing this to rot, not only causing emissions but also major local environmental problems. The growing problems of dealing with MSW is proving to be one of the major environmental problems in the Arab region.

2. EXPECTED END OF PROJECT SITUATION

The waste treatment system of this project will have many environmental advantages and socioeconomic effects and will make an important contribution to the reduction in CH_4 emission to the atmosphere and in the consumption of fossil fuel, thereby also reducing the net emission of CO_2. A description of the amounts of waste to be treated, power production and greenhouse gas reduction is given below.

An integral part of the project is the establishment of Jordan's internal capability for sustaining and replicating this type of project. It includes the educational, governmental, and social infrastructures necessary for such activities. Below, the expected specific results of the project are outlined with respect to greenhouse gas reduction, electricity production and waste treatment.

2.1. Construction and operation of the municipal and industrial organic waste-treating biogas plant - amounts of waste to be treated, power production and greenhouse gas reduction

The overall reduction in greenhouse gas emission to be achieved by treatment of 875,000 tones of the organic waste generated annually in Jordan, as estimated for possible replicable projects in Jordan, is equal to 34,700 tones of CH_4 annually assuming that 75% of the waste would be degraded anaerobic if deposited in a landfill. The fossil fuels replaced by the biogas that could be produced from this waste with 100% anaerobic digestion (46,300 tones CH_4) equals 59,000 tones of diesel oil with net CO_2 emissions of approximately 185,700 tones per year.

The plant to be built in this project will generate 5200 m^3 of CH_4 with daily input of approx. 50 tones of waste; a system installed in the new landfill will generate 2600 m^3 CH_4. Altogether 7800 m^3 of CH_4 will be generated daily which is equivalent to 1 MW. If the waste were deposited in the landfill as it is today and partly digested anaerobically, one would expect a release of 1,540 tones per year of CH_4. The total amount of biogas generated corresponds to a substitution of 1,910 tones of diesel oil/year equivalent to a CO_2 emission of 5,950 tones per year. The CO_2 equivalent of the reduction in CH_4 and CO_2 emission can be estimated to 21 x 1,540 + 5,950 = 38,290 tones of CO_2 per year.

The biogas plant will be economically viable with an annual net profit of USD 75,000 after part of the profit has been set aside for replicable projects. The profit will be derived from the production of 7.2 GWh of electricity, powering the equivalent of 2,400 average Western European households per year. Furthermore, once a market for fertilizer is established in Jordan, an additional annual income of 87,000 JD (USD 125,000) can be expected. Income from the sale of these products will be used to cover all operating costs of the plant and to promote the education in and the dissemination of biogas technology in Jordan. Jordan's national power utility, JEA, has to connect the biogas plant to the public grid, and to pay market rates for the biogas generated electricity.

The gross profit expected to be generated from the plant is about USD 175,000/year. Part of this income, approx. USD 100,000, will be set aside for education and training and for project replication.

2.2 Infrastructure for sustainable and replicable projects

A combination of several factors serves to ensure the sustainability of the project. First, the Jordanian Government puts great emphasis on the development of local energy sources based on indigenous resources, this being one of the central pillars of the Government's national energy plan.

Secondly, the Jordanians are generally highly educated and have shown great skill in transferring and implementing advanced technologies from abroad.

Thirdly, an integral part of the project is the establishment of Jordan's internal capability to sustain and replicate this project type. It includes the educational, governmental, and social infrastructures necessary for such activities. The backbone of these programmes will be the training, both theoretical and practical, of not only the Jordanians immediately responsible for the daily operation and maintenance of the biogas plant, but also the University of Jordan and Government officials, both national and municipal, as well as several NGOs.

Further details on the training program including barriers that must be overcome can be found in chapter B 6 and in Annex III.

3. TARGET BENEFICIARIES

* The general population of Jordan - The waste treatment plant will produce electricity, a needed commodity in Jordan at a competitive price. The electricity produced will be delivered to the national power grid.

* The general population of the city of Amman - Municipal and industrial waste handling in Amman is well organized. However, with the present landfill operation, major problems will occur in addition to the release of greenhouse gases. Such problems are smell, possible leakage from the landfill and the danger of fires and explosions. The completed bioenergy plant will collect, receive and dispose of Amman's organic waste, thus improving the living standard of the

city dwellers and improving the general economy of waste disposal in the city to the benefit of both the population and industry.

* The Ministry of Energy, GAM and JEA - The construction and operation of this new form of bioenergy plant for the Middle East will be a success in development and cooperation for the various governmental bodies involved.

* The University of Jordan - the Department of Civil Engineering and Department of Microbial Biotechnology will be major recipients of training and analytical/educational materials in their capacity as consultants to the bioenergy plant and in their role as the Jordan scientific center of biogas-process evaluation for replicable projects.

* Environmental NGOs will benefit from training and from involvement in public outreach activities.

4. PROJECT STRATEGY AND IMPLEMENTATION ARRANGEMENTS

4.1 Project implementation

The responsibility for the construction and operation of the biogas plant will be shared by the Municipality (GAM) and Jordan Electricity Authority (JEA). These two institutions have formed a joint venture called "Jordanian Biogas Based Electric Power Generating Organization (JBO)" in order to make this project possible. A copy of the draft joint venture agreement can be found in Annex VI in which the institutional responsibilities for the Joint Venture Agreement are elaborated.

The responsibility for the implementation of the activities of this project are allocated to the following parties:

- The Ministry of Planning (MP)
- The Ministry of Energy and Mineral Resources (MEMR)
- Contractor 1 (design and construction)
- Contractor 2 (training and education)
- University of Jordan (UJ)
- Greater Amman Municipality (GAM)

- Jordan Electricity Authority (JEA)
- Jordan Biogas Based Electric Power Generating Organization (JBO), represented by the plant manager, who must be appointed at the start of the project.
- Jordan Environment Society (JES)
- Queen Alia Fund (QAF)

Target Beneficiary

The roles of the various ministries and institutions are described below. However, as biogas technology is new in Jordan, two types of international advisors will be used. These advisors (henceforth referred to as Contractor 1 and Contractor 2) will be hired by the executing agency of the project with the approval of UNDP.

The roles of Contractor 1 and Contractor 2 will be:

Contractor 1 (design and construction)
Responsibility regarding supply of material for the plant, provision of detailed design and construction drawings, construction, commissioning and guarantee of methane production for at least two year after commissioning.

Contractor 2 (training and education)
Responsible for the training and capacity building program. Contractor 2 will have access to a similar operating plant outside Jordan, where the practical training can be carried out. Contractor 1 and 2 could be the same company.

Contractors 1 and 2
These contracts will be established through international competitive bidding under standard procedures. The contract awarded to Contractor 1 will include sufficient provisions to ensure that the Contractor 1 guarantees: (1) the reliable production of methane from the biogas reactors and (2) its reliable firing in the gas engine. These guarantees should extend over at least two years in order to ensure the good performance of the plant. Retention money and/or enough satisfactory guarantees will be provided by the Contractor as a guarantee to the reliability and safe performance of the plant.

Contractor 2 will be required to provide training to the JBO personnel and others on methods of operating and maintaining a biogas electricity generating plant.

Project Initiation Consultant

The Project Initiation Consultant, in close consultation with JBO and UNDP, will be responsible for tender preparation (for other tasks of the Project Initiation Consultant, see Annex IX). The Project Initiation Consultant will further be present at the commissioning test to certify to UNDP and the Government that the plant performance and output comply with the specifications.

4.2 General implementation and coordination

A Special Consultative Committee (SCC) will be established under this project. The SCC's main responsibility is to assist with the information exchange, coordination and training aspects of this project. The SCC is thus a consultative group which will guide these and future activities aimed at utilizing municipal solid waste for the production of energy. Furthermore, the SCC will disseminate information regarding this project inside and outside Jordan. The SCC will be chaired by the Ministry of Planning. UNDP will also participate in all SCC meetings.

Members of Special Consultative Committee (SCC) and their areas of responsibility:

Ministry of Planning:	Overall planning in Jordan
Ministry of Energy and Mineral Resources (MEMR):	Planning and coordination of new and renewable resources
Jordan Electricity Authority (JEA):	Generation and distribution of electricity
Greater Amman Municipality (GAM):	Waste collection and management in Amman
Jordan Environment Society (JES):	Enhancing awareness of environmental issues
Queen Alia Fund (QAF):	Enhancing status of women; improving information and outreach to women

The Special Consultative Committee will follow the plant operation and will further have the responsibility to advise on the allocation of the USD 100,000 generated annually as part of the income from the biogas plant. This sum will be used for training purposes. The above mentioned committee will have over-all advisory responsibility for the promotion of biogas technology in Jordan.

4.3 Practical implementation by the Jordanian Biogas Based Electric Power Generating Organization (JBO)

A number of people will be employed by the JBO and paid by the Government of Jordan as part of the Government contribution to the project. When the plant is fully operational, these staff will be remunerated from the income generated at the plant.

The JBO will operate under the following basic principles:

1. Economic and technical responsibility for the operation of the plant.

2. Annual presentation to the Special Consultative Committee (SCC) detailing the economic status of the plant as well as budgets for the coming two year period.

3. The income from the sale of electricity, methane and fertilizer will be used to cover the operation costs, i.e. salaries, maintenance, spare parts etc.

4. The profit will be used for expanding the plant and for promoting other replicable projects. However, part of the profit (estimated at USD 100,000 annually) will be transferred to cover an integrated training programme on a number of levels: education at the university; training in the public sector and on a commercial level in subjects related to methane release and utilization.

As part of the joint venture agreement, JEA has agreed to distribute the electricity and make the necessary electrical connections to the network and GAM has agreed to build the roads, fences and the foundation of the plant.

JEA will pay an agreed rate for the electricity of 4.7 cents/kWh (rate paid by GAM). This rate will be negotiated annually as part of JBO's general negotiation with JEA.

For the first 2 years of plant operation the value of fertilizer is set at zero, as this type of fertilizer is a new product in Jordan. After introduction on the market, a price per tone of 3-5 JD can be expected. This could add a potential annual income of 87,000 JD (corresponding to USD 125,000).

Based on these prices it will not be necessary to subsidize the plant once it is operating. The overall annual budget is projected as follows:

Annual expenditure	
Maintenance: 3% of the cost of investment USD 2.5 million	USD 75,000
Operation	USD 50,000
Sundries	USD 38,000
Total	USD 163.000
Income	
Sale of 7.2 GWh of electricity at 4.7 cents =	USD 338,000
Gross profit	USD 175,000
Set aside for training purposes and replication	USD 100,000
Net profit	USD 75,000

In addition, income from the sale of fertilizer is expected after year 2.

4.4 NGO involvement

The Jordanian Environment Society (JES) is the major NGO in Jordan which is engaged in the control and prevention of pollution in urban areas. JES is also heavily involved in public awareness and dissemination of information concerning environmental preservation. The Society has a close working relationship with the Greater Amman Municipality and regularly assists the Municipality in its efforts to ensure cleanliness in the city and to educate the public with respect to means of pollution prevention. JES will be represented on the Special Consultative Committee (SCC).

As one of the main aims of the project is pollution prevention, JES will work in association with the GAM towards educating and assisting the public in clean ways of handling MSW and in separation of waste, into industrial waste and domestic waste, particularly in large institutions. JES will undertake this through its publications and advertisements and the seminars it regularly organizes as well as via training and public awareness campaigns, conducted in association with the Municipality, particularly among school children.

JES will arrange a major seminar with the participation of the Municipality, the Ministry of Energy and JEA to explain the project to the public and raise awareness regarding its major environmental, local and global benefits. Through its many branches in Jordan, JES will be able to disseminate information about the project to other municipalities to enable a country-wide adoption of clean technologies for handling and treating MSW.

Furthermore, the Queen Alia Jordan Social Welfare Fund (QAF) will be actively involved with the implementation of activities that deal with outreach to women on issues pertaining to household waste management.

5. REASONS FOR ASSISTANCE FROM UNDP/GEF

The project is developed in line with the GEF Operational Strategy's Sixth Operational Programme: *"Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs"*

In view of the many urgent needs in Jordan, a project like this, however useful, will not be initiated without the support of GEF. The technology proposed, though solidly based on the extensive experience of similar programs in developed countries, has never been demonstrated in a developing country. This means that a recipient country wishing to independently fund such an undertaking would have to overcome significant technical, non-technical and financial barriers. Without full GEF support for the first plant, the project would most likely not be implemented, despite the modest secondary potential for profitability. In spite of the anticipated financial viability of such a biogas plant, it is clear that multinational, regional and national banks are not likely to grant loans for such an enterprise until its feasibility is fully demonstrated in the Middle East. It is the aim of this project to provide this form of demonstration. A combined landfill biogas plant has not been demonstrated in a Middle East context but the technology is no more complex than existing non-biogas commercial energy establishments in Jordan; moreover, the technology is well established in Europe.

The project will address a number of ***barriers***. These are: information barriers, capacity barriers and technology barriers. These barriers are outlined in greater detail in the GEF Project Brief under which the funding for this project was allocated. The activities designed in the present operational project document are entirely derived from the barrier analysis in the Project Brief. The project brief is available upon request.

By removing the identified barriers, the project covers the ***incremental costs*** for applying the biogas technology. The baseline situation is that the rapid growing population of Amman and Zerka (Amman and Zerka is growing by about 5%) will by year 2000 generate an amount of collected municipal waste exceeding more than 2,300 tones daily.

As all this waste would go into one single landfill. This situation compares well with similar problems in all large cities in the Middle East, Africa and Asia. Based on an estimated annual emission of CH_4 and CO_2 in Jordan of 120,000 tones (166 million m^3) and 12 million tones respectively, the implementation of biogas and landfill gas technology in Jordan has the potential of a reduction of the total CH_4 emissions by 33.4% and of the total CO_2 emissions by 2.2%.

By removing the barriers to this technology in Jordan and the Middle East, the present project will ensure the application of this technology on a large number of replicable projects. In Annex V a calculation of the replication cost is included. Given a production price of 5.6 cents per kWh from the demonstration plant compared with the present price today in Jordan of 4.7 cents per kWh, the project clearly includes the elements needed for the assurance of replicability.

6. SPECIAL CONSIDERATIONS

The Environment

The proposed plant will have the capacity to treat about 60 tones of organic waste per day, or about 4 percent of the daily waste generated in the capital city. The project combines methane emission reduction with new ways of producing electricity and fertilizer for surrounding farms. Among other positive impacts, the project will therefore also help to reduce Jordan's dependency on oil imports.

The main objective of this project is to demonstrate the environmental and energy-generating benefits of extraction of methane gas from an existing landfill in Amman and of the utilization of pure organic municipal and industrial waste for biogas production in a controlled reactor. Treated in a biogas plant the municipal organic waste is almost totally converted to energy (as methane) and organic fertilizer for the surrounding farmland. The landfill gas system has the potential for extraction of approximately 25% of the potential methane generation within the landfill.

A method for utilizing municipal solid waste for energy production is to deposit the waste in properly covered and protected landfills, where the organic matter is degraded under anaerobic conditions during in a period of 10-30 years. The generated methane gas is then extracted through a specialized gas drainage system.

A cleaner way, introduced in this project, is separate treatment of "clean" organic waste in a biogas plant, where the organic matter is degraded under controlled anaerobic conditions in large reactor tanks. Here the organic matter is degraded in about two weeks, generating about 300-400 m^3 of methane per tone of dry waste matter at a degradation rate approximately 800 times that of the landfill gas system.

Assuming a dry matter content of 30% VS (volatile solids) and assuming further that 75% of the organic matter is anaerobically degraded if deposited in the landfill due to compacting and soil covering, the demonstration biogas plant thus represents a reduction in the CH_4 emission to the atmosphere of approx. 1.21 million m^3 annually, based on an input of 50 tones per day.

The landfill gas plant has an estimated capacity for extraction of approx. 0.93 million m^3 of CH_4 annually.

The total contribution to the reduction in emission of methane for the two demonstration plants is thus 2.14 million m^3 or 1,540 tones of CH_4. In addition, the equivalent of 1,910 tones of diesel oil is substituted, resulting in a reduction in net CO_2 emissions of 5,950 tones per year.

Technical Co-operation among Developing Countries

An integral part of this project is the use of profits derived from the sale of products from the bioenergy plant for replicable projects. In that connection, part of the income from the JBO has been earmarked for replicable projects, training and education. The biogas plant will also act as a forum where representatives from other interested developing countries can see an operating bioenergy plant and receive an introduction to biogas technology. The ultimate goal is technological exchange and transfer among the developing countries for dissemination of this type of greenhouse-gas-neutral bioenergy technology.

Another center for biogas technology has been established in Africa in connection with the GEF and DANIDA funded Takagas project. It is the intention to exchange information with this project. Moreover, contacts will be established with biogas plants operated in similar climatic zones as well as other GEF funded biogas initiatives.

A potential partner in the future may be found in China, where initiatives have been taken to exchange information with the Chinese State Science and Technical Committee, that has the responsibility for running about 25 major biogas plants.

Co-operation with non-governmental organizations (NGOs)

In the section on Project Strategy and Implementation Arrangements, the cooperation with the Jordan Environment Society (JES) and the Queen Alia Fund (QAF) is mentioned. It is the intention to let these NGOs work out a concerted plan of action for public information/education outreach to be approved by SCC. An allocation of USD 72,000 has been set aside in the budget and the SCC has been given the task to promote outreach activities using part of the revenue from the USD 100,000 generated annually from JBO.

Involvement with the Private Sector

The waste producing industries include vegetable markets and slaughterhouses. The main slaughterhouse in Amman processes an average of 1,200 sheep, 70 heads of cattle and 25,000 chickens per day. This slaughterhouse alone produces 23 m^3 of blood waste and 11 tones solid waste a day, equal to an annual quantity of 6,000 m^3 liquid waste and 2,900 tones of solid waste; a total average of 24 tones per day.

Contacts have been made with private companies producing the above-mentioned biodegradable waste, as well as with restaurants and hotels, olive factories, dairy industries, leather tanning industries and various farm industries.

In conclusion it should be mentioned that most of Jordan's electricity sector is privatized and non-subsidized.

Gender

The Queen Alia Jordan Social Welfare Fund (QAF), which is one of Jordan's largest NGOs, is devoted towards enhancing the status of women and assisting women's role in training and self-reliance through job creation. Women's participation in household waste management, environmental cleanliness and prevention of pollution is one of the main interests of QAF.

The Queen Alia Fund normally cooperates with the Jordan Environment Society (JES) in activities relating to the environment. It is the intention of the project that cooperation between these two important Jordanian NGOs in the field of environmental protection can ensure the implementation of a concerted plan of action.

7. CO-ORDINATION ARRANGEMENTS

Both the JEA and the GAM will be involved in the actual implementation of the project. As mentioned above, JEA and GAM will form a joint venture, the Jordan Biogas Based Electric Power Generating Organization (JBO). JBO will be responsible for the biogas and landfill plant.

Further detail on the coordination arrangements are given in the section on Project Strategy and Implementation Arrangements.

8. COUNTERPART SUPPORT CAPACITY

Jordan has no indigenous energy resources and relies almost entirely on imports, therefore the development of indigenous resources including new and renewable sources of energy has always been encouraged by the Government. This is reflected in all of Jordan's National Development Plans, particularly the latest Fifth National Five Year Plan 1993-1997.

The energy sector in Jordan is supervised by the Ministry of Energy and Mineral Resources (MEMR). According to its mandate, MEMR is responsible for carrying out planning, policy formulation, energy conservation, renewable energy development and for the import of crude oil and petroleum products. MEMR has formulated an energy strategy for Jordan. The main elements of this strategy focus on: (I) reducing the country's dependence on imported oil by developing domestic energy resources and by increasing energy efficiency through conservation, demand management and pricing measures; (II) providing economic and diversified energy supplies including encouragement of renewable energy; (III) adopting pricing policies to ensure the economic efficiency and financial viability of energy sector entities; and (IV) protecting the environment by reducing the emissions and the pollution caused by the implementation of energy projects.

Jordan has a strong academic and scientific institutional set-up quite capable of absorbing new technologies such as that of "waste-to-energy-conversion" and to help in disseminating these in the Arab region. Therefore, the project goes far beyond mere construction of a facility producing energy from waste. It aims at transferring technology and know-how to the country and, via the country, to the region. The involvement of universities and scientific institutions has therefore been emphasized throughout the project.

Under the joint venture arrangement, the Municipality will be responsible for collecting and separating the waste and delivering it to the biogas plant. JBO will be responsible for the production of the biogas, operating the gas engines and selling the electricity, the compost and disposing of the refuse. JBO will endeavor to operate on a commercial basis from its initial inception and thus to generate profits which will be fed back into the project to expand it and improve its performance.

Both the Municipality and the Jordan Electricity Authority have a large number of well qualified employees capable of operating and maintaining this project. The Municipality runs one of the most efficient MSW managed systems in the region, and JEA also operates a most reliable electric power network and has vast experience in running generating plants and gas engines.

Both the Municipality and JEA will provide the local counterpart support and funding by providing the local infrastructure, building local facilities including connecting the new gas plant to the national electric network and provide staff to operate the plant successfully.

C. DEVELOPMENT OBJECTIVE

To reduce biodegradable waste accumulation in Jordan, thereby improving Jordan's environment and reducing global emissions of greenhouse gases (CH_4 and CO_2) while at the same time reducing the dependency of oil imports. The overall objective will be reached by introducing biogas technology. Combined with the introduction of a new environmentally friendly technology a capacity training program will ensure the project sustainability.

D. IMMEDIATE OBJECTIVES, OUTPUTS AND ACTIVITIES

Immediate Objective 1 (Capacity and Technology barrier)

An overall controlled treatment of 18,300 tones of municipal waste per year, subsequently reducing methane (CH_4) emissions into the atmosphere by 1,540 tones annually as well as a reduction of CO_2 emissions by 5,950 tones annually through the utilization of the methane content of the biogas produced from the waste for replacement of fossil fuel.

Success criteria

The criteria of success is primarily to finish the construction of a treatment plant, to ensure a continuous supply of organic waste for the plant and to start the biological processes in the biogas reactor for methane production.

Output 1.1

Construction, start-up and commissioning of a combined landfill gas plant and medium-scale demonstration biogas plant for treatment of organic municipal and industrial waste in Amman

Activities	Timing month	Responsibility
1.1.1 Initiation by Project Initiation Consultant. Please refer to Annex IX for Terms of Reference of this consultant.	1-6	UNDP
1.1.2 Detailed design of the demonstration landfill and biogas plant.	1-5	GAM, JEA, Contractor 1

1.1.3 Ground preparation and fencing of the site for the landfill and biogas plant.	1-3	GAM
1.1.4 Selection and purchase of equipment for the landfill and biogas plant.	1-3	Contractor 1 Plant Manager
1.1.5 Construction and assembly of the landfill and biogas plant.	3-12	Contractor 1 Plant Manager
1.1.6 Connection to the public electricity grid.	10-12	JEA
1.17 Start-up and commissioning of the biological processes in the biogas reactor, electricity generating equipment and the landfill operations.	13-20	Contractor 1, JEA

Output 1.2

A detailed plan for the collection, transport and landfilling of organic waste resources. Such a plan will include methods to ensure the sustainable production of high quality landfill gas from the existing landfill. The plan will be based on studies of available waste resources made by the GAM.

Activities	**Timing Months**	**Responsibility**
1.2.1 Selection of the optimal composition of waste resources for the biogas plant and elaboration of a plan for collection of these waste resources. This plan will be made in close cooperation with the City Council and the waste generating industries.	5-6	GAM, Contractor 2
1.2.2 Examination of the composition of landfill gas and the possibility of feeding this gas to gas engines.	7-10	GAM, Contractor 2

Immediate Objective 2 (Capacity barrier)

An improved basis for an enabling environment which lends itself to institutional security for the demonstration biogas plant and to national planning for bioenergy in Jordan.

Success criteria

Verification of an operating budget for the combined landfill and biogas plant. Successful take-over of the operation and management of the combined landfill and biogas plant by national staff. A National Plan for further expansion of this technology through replication initiatives.

Output 2.1

A verified operating budget for the combined landfill gas plant and biogas plant with detailed figures for expenses and income based on signed agreements with purchasers of electricity and suppliers of organic waste products.

Activities	Timing Months	Responsibility
2.1.1 Agreement with JEA or interested private companies on the tariffs and mode of payment for electricity produced by the biogas plant.	1-6	MP, MEMR, JEA, JBO
2.1.2 Agreement with the Greater Amman Municipality concerning delivery of waste to the plant. This agreement should be coordinated with tariffs for waste delivered to the landfill.	3-6	GAM, JBO, Plant manager
2.1.3 Agreements with different industries on the delivery of waste products to the combined landfill and biogas plant.	3-6	GAM, JBO, Plant manager
2.1.4 Elaboration of maintenance plan for the combined landfill and biogas plant.	12-14	Contractor 1, JBO, Plant Manager

2.1.5 Preparation of an operating budget based on the output of activity 2.1.1 - 2.1.4.	14-15	Contractor 1, JBO, Plant manager
2.1.6 Management of the combined landfill and biogas plant by experts	18-36	Contractor 1 + 2 Plant Manager

Output 2.2

As an important part of the project the Jordanian authorities have agreed to prepare a master plan for bioenergy for Jordan. This plan will be made with the assistance of external experts, but it will be an integral part of Jordan's overall energy policy. The plan will include outlines for at least 5 replicable biogas projects (to be funded from private investment resources) based on anaerobic digestion and biogas production from municipal organic waste and organic waste.

Activities	Timing Months	Responsibility
2.2.1 Elaboration of master plan for bioenergy in Jordan and its formal presentation to MEMR and MP.	12-18	MP, MEMR, Contractor 2
2.2.2 Elaboration of plans for replicable projects.	18-24	MEMR, JBO, Contractor 2
2.2.3 Design least cost future investment program for the utilization of MSW as an energy source.	20-24	Contractor 2, JBO, MEMR
2.2.4 Complete an assessment of potential sources of investment finance including Jordanian and external private sector financing.	12-24	Contractor 2, JBO, MEMR
2.2.5 Preparation of an investors portfolio which outlines the investment potential and opportunities in the field of biomass/biogas to energy.	12-24	Contractor 2, JBO, MEMR

2.2.6 Encouragement of replication through outreach to potential investors using seminars portfolios.	12-24	Contractor 2, JBO, MEMR

QAF - Capacity of the Queen Alia Jordan Social Welfare Fund to implement part of a concerted plan of action for outreach among women for household waste management issues together with JES.

Output 3.1

A number of community level actions creating a broader awareness of pollution prevention and the role and possibilities for women in this context. The activities will also result in a higher level of information and popular involvement of local communities on issues pertaining to waste management and its potential in energy production and impact on environmental pollution in the context of Jordan. Moreover, an increased level of information and awareness at the policy making level will work to the lay the foundation for future replication activities.

For details of the training activities, please refer to Annex III.

Activities	Timing Months	Responsibility
3.1.1 Study of MSW of Greater Amman Area: quantities and constituents (with seasonal variations), present methods of collection and transport, dumping and disposal and the segregation of "clean" waste.	8-15	JES, QAF, UJ, GAM
3.1.2 Estimation of emissions and other environmental impacts from the present MSW.	2-8	JES, UJ
3.1.3 Introduce and implement methods of to ensure immediate and cleaner handling of all MSW available in GAM.	2-8	GAM, JES
3.1.4 Inform policy makers regarding technological choices available in Jordan for energy from hydrocarbon alternatives.	6-12	JES, UJ
3.1.5 Involvement of Jordanian NGOs in outreach	2-	SCC, QAF, JEA

work to create broader awareness of pollution prevention and the role and involvement of women in household waste management issues.		GAM
3.1.6 In conjunction with established plant and in cooperation with Jordanian Scientific bodies, establish a small outreach center which can conduct briefing sessions, tours, and provide information dissemination on the possibilities of biogas and other lessons learned.	4-	SCC, JES, QAF, GAM, JEA

Output 3.2

A thoroughly trained local staff capable of the operation and management of the combined landfill and biogas plant

Activities	Timing Months	Responsibility
3.2.1 Training of the plant manager, technicians and plant workers. Further details of the training is found in Annex III.	4-9	Contractor 2
3.2.2 Training of workers, carried out by trained technicians under the supervision of local experts.	9-16	JBO, Plant Manager, Contractor 2
3.2.3 In service training of the plant manager, the plant technicians and the workers. This training will be done under the supervision of Contractors 1 and 2.	10-18	JBO, Contractor 1 Contractor 2

Output 3.3

Upgraded capacity of GAM, JEA, MEMR and JBO to include technical know-how of medium and large scale biogas plants, landfills and their operation. The activities will work

towards establishing the much needed confidence in the technology at hand, thereby ensuring replication.

Activities	Timing Months	Responsibility
3.1.1 Training of administrative and technical staff from GAM, JEA, MEMR and JBO at a full-scale biogas plant and at an operating landfill plant in Europe.	2-8	Contractor 2
3.1.2 Provision of training of technical personnel, technicians and design engineers in the technical choices and possibilities of bioenergy from biogas reactors and landfills.	2-8	Contractor 2

Output 3.4

An upgraded capacity at the MEMR, especially the Renewable Energy Unit, that would enhance the capabilities needed for planning renewable energy from biogas, for initiation of replicable projects, for dissemination of knowledge about bioenergy and for the overall administration and supervision of bioenergy projects in Jordan.

Activities	Timing Months	Responsibility
3.4.1 Training of technical staff from the Ministry of Energy's Renewable Energy Unit at a European center. This center should be leading its local national planning in the area of bioenergy production and utilization.	2-8	Contractor 2

Output 3.5

An upgraded capacity and know-how at the University of Jordan in the field of biogas technology. This will increase UJ level of involvement (nationally and internationally) in issues pertaining to biogas as a renewable energy option. As a result, the UJ will also be capable of evaluating potential sources of high quality waste and estimate possibilities of replication.

Activities	Timing Months	Responsibility
3.5.1 Installation and commissioning of modern laboratory equipment for research and education in the biogas area at UJ.	8-15	Contractor 2 UJ
3.5.2 Training of academic staff from UJ at a biogas center in Europe or elsewhere, with climatic conditions similar to Jordan. This center must be actively involved in research and development in the field of biogas science and technology.	2-8	Contractor 2
3.5.3 Supervision of the trained UJ staff by external experts. The trained UJ staff will commence supervised work and research (in the context of Jordan) in the field of biogas technology.	12-36	Contractor 2
3.5.4 Encouragement of twinning arrangements with centers of bioenergy. These centers will facilitate the Jordanian scientists access to information on biogas technology and it will facilitate the transfer of technology to Jordan.	12-36	Contractor 2

E. INPUTS

1. GOVERNMENT INPUT

1.1 Personnel

The Government will make the services of the existing staff of the Ministry of Energy and Mineral Resources, the Jordan Electricity Authority and the Greater Amman Municipality available to the extent and at the time required for successful implementation of the project.

The following staff will be appointed for the project for a fixed duration:

Ministry of Energy and Mineral Resources (MEMR) and Jordan Electricity Authority (JEA) and PCE.	**p.m.**	**Value in JD**

Staff for project administration and staff for upgrading of institutional know-how, including staff for participation in the training program and in development of plans for bioenergy.

Administrative Director	24	18,000
Project officer, master plan for bioenergy	24	15,000
Project officer, plans for replicable projects	24	15,000
Secretary	24	7,000
Driver	24	5,000

Greater Amman Municipality

Staff for waste management coordination:

Waste management coordinator	24	18,000
Waste management officer	24	15,000
Secretary	24	7,000
Driver	24	5,000

The following staff will be appointed for specific project tasks for the duration necessary to fulfill these tasks, including staff for participation in the training program:

JEA	p.m.	Value in JD
Staff needed for preparation of specifications and assistance for construction and maintenance of connections to the public grid:		
Electric engineer	12	7,500
Electric technician	6	2,500
Driver	12	2,500
Subtotal input personnel (1.1)	**JD 117,500 ~**	**USD 166,000**

1.2 Equipment and facilities in USD	Responsible	
Buildings	GAM	225,000
Ground preparation	GAM	100,000
Foundation of reactor and storage tanks	GAM	100,000
Sorting area 1500 m^2	GAM	28,000
Connection to the network	JEA	700,000
Subtotal input equipment and facilities (1.2) USD		**1,153,000**
INPUT FROM GOVERNMENT, GRAND TOTAL:		**1,319,000**

Exchange rate: 1 USD = 0,708 JD (April 1997)

2. UNDP/GEF INPUT

Justification for procurement of large equipment component (budget line 46.00)
This project is a demonstration project with the distinct objective to demonstrate the viability of biogas plant operation and land fill gas extraction in Jordan in order that GHG reduction can be achieved through this and the anticipated replication initiatives. The project is therefore designed entirely around (i) the establishment of the plant and landfill extraction operation and (ii) the creation of capacity in Jordan for the future management and replication of this initiative.

In line with these objectives, therefore, the project includes a large equipment component, including the establishment of (a) the biogas plant; (b) the power generation system and(c) the landfill system. These three budget items (i.e. budget lines 46.01, 46.02 and 46.03) amount to a total of $2,763,500.

Without these large infrastructure and plant components, the project cannot meet its stated objectives.

2.1 DEMONSTRATION PLANT

The project will be nationally executed with the Ministry of Planning having the overall responsibility and the daily execution carried out by a joint venture between JEA and GAM (JBO).

The information and outreach component of the project will be administered in accordance with recommendations from SCC. The contractors for the construction and training will be implemented through turnkey contracts.

The GEF/UNDP inputs are as follows:

2.1.1 Project management

	p.m.	Value in USD
The overall project management to be carried out in cooperation between JBO and Contractor 1. However since neither JEA or GAM have their own		

expertise, JBO will be required to hire external consultants to assist in preparing tender documents and evaluation of biogas plant performance.

a.	External expert, JEA and GAM	4	35,000
b.	Management expert, Contractor 1	4	40,000
c.	Commissioning expert, Contractor 1	4	40,000
d.	Supervisory missions		30,000

2.1.2 Biogas plant construction and commissioning

The design and supervision of the construction and commissioning of the biogas plant to be conducted by Contractor 1.

a.	Biogas plant design engineer, Contractor 1:	7	65,000
b.	Construction supervision expert, Contractor 1:	9	85,000

2.1.3 Backup activities for replicable projects

a.	Preparation of detailed plan for collection & transport of MSW. Support to GAM program.	15,000
b.	Determination of optimum composition of waste and elaborate on plan for collection of waste. Support to GAM program	15,000
c.	Preparation of master-plan for bioenergy in Jordan Ministry of Energy	15,000
d.	In conjunction with established plant and in cooperation with Jordanian Scientific body (e.g. University of Jordan or Jordan Scientific Society) establish a small outreach center which can conduct briefing sessions, tours, and provide information dissemination on the possibilities of biogas and other lessons learned	15,000

2.1.4 Combined landfill and biogas plant and waste collection equipment

a.	Biogas plant (2,000 m^3 reactor)	1,743,500
b.	Power generation system	700,000
c.	Landfill gas system	320,000

For a detailed listing and specification of equipment needed and its cost, please refer to Annex VII.

Subtotal Demonstration Plant **3,118,500**

2.1 TRAINING, BIOGAS PLANT OPERATIONS MANAGEMENT AND COMMUNITY OUTREACH AND INVOLVEMENT

2.1.1 Biogas plant operation and maintenance management.

a.	Biogas plant operations expert, Contractor 2	16	155,000

2.1.2 General Training

The training programs include training personnel, accommodation of trainees, travel, training facilities and materials. Please refer to annex for details of the training.

a.	Training of technicians in technical choices & possibilities of bioenergy	8	80,000
b.	Upgrading of capacity at GAM, JEA & JBO personnel regarding know-how	15	150,000
c.	Establish twinning arrangements between UJ and bioenergy		

specialists	4	40,000

2.1.3 Laboratory equipment

Upgrading of the laboratory equipment at UJ

a.	Laboratory equipment for training in anaerobic digestion of organic waste:	42,000

Subtotal training	**467,000**

2.3 INFORMATION AND OUTREACH

Support to environmental and women's NGOs involved in environmental conservation to lead sensitization campaign in the community to encourage clean collection and segregation of MSW. Involvement of the community and industry in identifying ways of securing clean handling of MSW and dissemination of information on the project in Jordan and the sub-region including seminars and public awareness campaigns.

a.	Information campaign in Amman regarding proper treatment of waste and reuse.	40,000
b.	Estimate from emissions & impact from present MSW	20,000
c.	Introduce and implement methods of handling MSW	50,000
d.	Finalize designs to utilize MSW as an energy source in GAM.	30,000
e.	Inform policy makers, intellectuals and media on technological choices available in Jordan for	

	energy from hydrocarbon alternatives.	35,000
f.	Involvement of NGOs in outreach work	40,000
g.	Assessment of MSW in Greater Amman area: quantities and constituents (with seasonal variations), present methods of collection and transport, dumping and disposal, and segregation of "clean" waste.	35,000
h.	Design least cost future investment program for the utilization of MSW as an energy source	35,000
Subtotal information and outreach work		**285,000**

2.2 Support Services to Country Office for services provided in relation to GEF project (budget line 54)

Justification:

Experience indicates that country offices are incurring a significant workload in relation to the identification, formulation processing, support and monitoring of GEF projects. In line with UNDP's financial regulations such support must be reimbursed and should be charged to the project budget.

Therefore, the country office requests reimbursement for the following services provided during the implementation of the project:

- Full time project support officer $ 60,000
- Site monitoring visits/travel costs $ 10,000
- Communication (fax, phone and e-mail) $ 16,500
- Contingency $ 20,000
- Miscellaneous $ 10,000

Subtotal reimbursement to Country Office		**$116,500**
2.4	**Reporting Costs and Sundries**	**$ 13,000**
TOTAL		**4,000,000**

F. RISKS

The risks associated with this program include:

PROBLEM

The gas from the landfill is polluted for a period of time and can not be used in the gas engines.

Solution

During landfill operations it is not uncommon that the methane from some of the pipes is polluted and cannot be fed direct to the biogas unit. The biogas plant includes a purification unit. Another solution is to feed the biogas plant so that the input contains more lipids. This will give a higher gas production from the biogas plant which can, for a period, compensate for the fluctuations in the amount of methane from the landfill. The best solution for the future operation of the plant and other replicated projects of this type would, however, be to implement the recommendations of the assessment proposed in activity 1.2.3 and thereby ensure a high quality of landfill gas from the Amman Landfill to be utilized in this and other biogas projects.

PROBLEM

The trained staff does not remain at the plant.

Solution

All trainees receiving their training outside Jordan will be required to sign contracts to work on the plant for a defined period of time (minimum three years). A combination of attractive salaries and the fact that the plant is the first of its kind in the region should not be sufficient to maintain the staff in a country where the number of well trained people is very high.

PROBLEM

Competition from the other energy sources makes electricity from the plant too expensive.

Solution

As 1) the electricity is sold to the grid at day-to-day market prices and 2) it is unrealistic to imagine a drop in the already low electricity prices in Jordan, this problem should not occur. Today, no other new and renewable energy sources (wind, solar energy) can compete with the electricity from biogas in Jordanian market terms.

G. PREREQUISITES AND PRIOR OBLIGATIONS

Prior obligations

- Assignment of counterpart personnel.
- Commitment of fund for activities listed in section E. Government inputs point 1.2. Cofinancing agreement with Government of Denmark secured.

The project document will be signed by UNDP and UNDP assistance to the project will be provided only if the prior obligations stipulated above have been met.

Prerequisites

A joint agreement has been signed between GAM and JEA on the formation of the Jordan Biogas Organization (JBO).

The project document will be signed by UNDP and UNDP assistance to the project will be provided, subject to UNDP receiving satisfaction that the prerequisite listed above has been fulfilled or is likely to be fulfilled. When anticipated fulfillment of the prerequisite fails to materialize, UNDP may, at its discretion, either suspend or terminate its assistance.

H. PROJECT REVIEWS, REPORTING AND EVALUATION

(a) Every six months the Administrative Director of the project (appointed by the Government) will prepare a progress report for the UNDP and the Ministry of Planning. These same reports will be sent to the Regional GEF Coordinator in UNDP New York.

(b) The project will be subject to tripartite review (joint review by representatives of the Government and UNDP) at least once every 12 months, the first such meeting to be held within the first 12 months of the start of full implementation. The national project coordinator and the executing agency will prepare and submit two months prior to each tripartite review meeting a Project Performance Evaluation Report (PPER). Additional PPERs may be requested, if necessary, during the project.

(c) An independent midterm evaluation will be undertaken by UNDP in collaboration with the relevant parties around month sixteen of the project. This activity will serve to evaluate the progress of the project in reference to the project plan, the objectives and the outputs which were set up at the project inception. Moreover, this activity will serve to recommend any action that is deemed necessary to remedy the project and restore it in the desired direction.

(d) A project terminal report will be prepared for consideration at the terminal tripartite review meeting. It will be prepared in draft sufficiently in advance to allow review and technical clearance by the Government and UNDP at least four months prior to the terminal tripartite review.

(e) The project will be subject to evaluation 6 months prior to its scheduled termination. The organization, Terms of Reference and timing of this review will be decided after consultations between the parties to the project document.

I. LEGAL CONTEXT

This project document shall be the instrument referred to as such in article 1 of the Standard Basic Assistance Agreement between The Government of Jordan and The United Nations Development Programme, signed by the parties on 12 January 1976. The host country implementing agency shall, for the purpose of the Standard Basic Assistance Agreement, refer to the Government cooperating agency described in that Agreement.

The following types of revisions may be made to this project document with the signature of the UNDP Resident Representative only, provided he or she is assured that the other signatories of the project document have no objections to the proposed changes:

Mandatory annual revisions which re-phase the delivery of agreed project inputs or reflect increased expert or other costs due to inflation, or take into account agency expenditure flexibility.

J. BUDGETS

Project budget covering Government contribution in kind

Country: Jordan
Project number: JOR/96/G31/A/1G/99
Project title: **Jordan: Reduction of Methane Emissions and Utilization of Municipal Solid Waste for Energy in Amman.**

DESCRIPTION	TOTAL		YEAR 1		YEAR 2		YEAR 3	
	p/m	JD	p/m	JD	p/m	JD	p/m	JD
PERSONNEL								
Personnel including maintenance of trainees salaries (E. INPUTS 2.2.2)								
Administrative director	24	18,000	12	9,000	6	4,500	6	4,500
Project officer, master plan for bioenergy	24	15,000	6	3,750	12	7,500	6	3,750
Project officer, replicable projects	24	15,000	6	3,750	12	7,500	6	3,750
Waste management coordinator	24	18,000	12	9,000	6	4,500	6	4,500
Waste management officer	24	15,000	12	7500	6	3,750	6	3,750
Scientific and engineering staff (1)	12	7,500	6	3,750	6	3,750	-	-
Technicians (1)	6	2,500	3	1,250	3	1,250	-	-
Secretary (2)	48	14,000	24	7,000	12	3,500	12	3,500
Drivers (3)	60	12,500	34	7,084	13	2,708	13	2,708
COMPONENT TOTAL	**246**	**117,500**	**115**	**52,084**	**76**	**38,958**	**55**	**26,458**
IN USD		**166,000**		**73,580**		**55,050**		**37,370**
Equipment	**USD**		**USD**		**USD**		**USD**	
Non-Expendable equipment								
Equipment for Electricity Grid-Connection		700,000		700,000				
Premises								
Buildings		225,000		225,000				
Ground Preparation		100,000		100,000				
Foundation for Reactor		100,000		100,000				
Sorting Area Preparation		28,000		28,000				
		1,153,000		**1,153,000**				
GOVERNMENT TOTAL USD	**246**	**1,319,000**	**115**	**1,226,580**	**76**	**55,050**	**55**	**37,370**

Exchange rate 1 USD = 0,708 JD (Apr. 97)

Project budget covering GEF contribution through UNDP

Country: Jordan
Project number: JOR/96/G31/A/1G/99
Project title: **Jordan: Reduction of** Methane Emissions and Utilization of Municipal Solid Waste for Energy in Amman.

	DESCRIPTION	TOTAL USD		Year 1 USD		Year 2 USD		Year 3 USD	
		P/M	Cost	P/M	Cost	P/M	Cost	P/M	Cost
10	**PERSONNEL**								
17.01	**Project Initiation Consultant**	6	70,000	6	70,000				
16	**MISSION COSTS**								
16.01	**Technical supervision**		30,000		10,000		10,000		10,000
16.02	**Mid-term Evaluation**		20,000				20,000		
19	**COMPONENT TOTAL**	6	120,000	6	80,000		30,000		10,000
20	**SUBCONTRACTS**								
21	**Experts/consultants**								
21.01	Contractor 1 *	24	222,000	6	58,000	18	164,000		
21.02	Contractor 2 *	16	155,000	1	10,000	6	58,000	9	87,000
21.03	NGOs	24	72,000	12	36,000	6	18,000	6	18,000
21.04	Information and outreach		166,000		50,000		50,000		66,000
21.05	Backup activities for replicable projects		60,000		15,000		15,000		30,000
29	**COMPONENT TOTAL**	64	675,000	19	169,000	30	305,000	15	201,000
30	**TRAINING AND FELLOWSHIP**								
32	**Group training**								
32.01	Training of technicians	8	80,000			4	40,000	4	40,000
32.02	Upgrading capacity at GAM,JEA and JBO	15	150,000	3	30,000	7	70,000	5	50,000
32.03	Twinning between UJ and energy specialists	4	40,000			2	20,000	2	20,000
39	**COMPONENT TOTAL**	27	270,000	3	30,000	13	130,000	11	110,000

40	EQUIPMENT				
41	Expendable equipment		-		
42	Non-expendable equipment				
46.01	Biogas plant **	1,743,500	493,500	1,250,000	
46.02	Power generation system **	700,000		700,000	
46.03	Landfill gas system **	320,000	147,000	173,000	
47.01	Laboratory equipment	42,000	42,000		
49	COMPONENT TOTAL	2,805,500	682,500	2,123,000	
50	MISCELLANEOUS				
52	Reporting costs	10,000			10,000
53	Sundries	3,000	1,000	1,000	1,000
54	Project Support Services	116,500	38,830	38.830	38,830
59	COMPONENT TOTAL	129,500	39,830	39,830	49,830
99	GRAND TOTAL	72 4,000,000	12 950,830	40 2,657,330	20 391,830
100	COST SHARING				
101	Government of Denmark	1,500,000			
109	COST SHARING TOTAL	1,500,000			
999	NET GEF /UNDP CONTRIBUTION	2,500,000			

* Details to be found in section E.2 UNDP input.

** Details to be found in Annex IV.

A EX I
Workplan

Immediate Objective	Output and Activity (by month)	Year 1												Year 2												Year 3											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
1. 18,300 tons of	1.1 Construction and start up of a landfill and biogas plant																																				
MSW is treated per	1.1.1 Initiation by Project Initiation Consultant																																				
year reducing CH4	1.1.2 Detailed design of the landfill and biogas plant																																				
emissions by 1540	1.1.3 Ground preparation and fencing of site																																				
tons and CO2 by	1.1.4 Selection and purchase of equipment																																				
5950 tons annually	1.1.5 Construction, erection and assembling of plant																																				
	1.1.6 Connection to the public electricity grid																																				
	1.1.7 Start up and comissioning of biological proces and electricity genrating facility.....																																				
	1.2 Detailed plan for collection & transport of org. waste																																				
	1.2.1 Selection of optimum composition of waste sources																																				
	2.2.3 Examination of composition of landfill gas																																				
	2.2.4 Prepare assesment of landfill gas quality																																				
2. The existing	2.1 A verified operating budget for plant with detailed figures																																				
basis for an	2.1.1 Agreement w. JEA or private companies of tariffs																																				
enabling environment	2.1.2 Agreement w. GAM on delivery of waste																																				
that lends itself to	2.1.3 Agreement w. industries on delivery of waste																																				
institutional security	2.1.4 Elaboration of maintenance plan for plant																																				
for the demo plant &	2.1.5 Preparation of an operating budget based on above																																				
to national planning	2.1.6 Management of plant by experts																																				
for bioenergy in	2.2 A master plan for bio energy in Jordan																																				
Jordan is	2.2.1 Elaboration of master plan for bio energy																																				
improved.	2.2.2 Elaboration of plans for replicable projects																																				
	2.2.3 Design least cost future investment programme.....																																				
	2.2.4. Complete assesment of potential sources of investment																																				
	2.2.5 Preparation of an investment portfolio which																																				
	2.2.6 Encouragement of replication through outreach ot investors																																				

Immediate Objective	Output and Activity (by month)	Year 1												Year 2												Year 3											
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12
3. The capability	3.1 A broader awareness of pollution prevention and role of																																				
of Jordan to manage	3.1.1 Study of MSW quanteties and constituents																																				
and convert MSW	3.1.2 Estimation of emissions and impacts from MSW																																				
to energy in a sust.	3.1.3 Introduce & implement methods of MSW handeling																																				
manner is enhanced	3.1.4 Inform policy makers on technological choices																																				
	3.1.5 Involvement of NGO's in outreach work																																				
	3.1.6 Establsih small outreach center which hcan conduct																																				
	3.2 Thoroughly trained local staff capable of the operation and management of the combined plant																																				
	3.2.1 Training of plant manager and tecnichians																																				
	3.2.2 Training of workers																																				
	3.2.3 In service training of plant manager, technicians and workers																																				
	3.3 An upgraded capacity of GAM, JEA and JBO																																				
	3.3.1 Training admin. and tech. staff																																				
	3.3.2 Training of technicians and design engineers in																																				
	3.4 Upgrade capacity at MoE's renewable energy unit																																				
	3.4.1 Training of academic staff of MoE in Europe																																				
	3.5 Upgraded capcity and know-how at UJ																																				
	3.5.1 Installation of modern lab. equipment for research																																				
	3.5.2 Training of UJ staff at a centre in Europe																																				
	3.5.3 Supervision of the UJ of external experts																																				
	3.5.4 Encouragement of twinning arrangements with																																				

Activities that are ongoing during the period

Activities that have definite and scheduled outputs over the period

ANNEX II.

SCHEDULE OF PROJECT REVIEWS, REPORTING AND EVALUATION

Proposed Starting Date:		1 Jul 1997
1.	Inception Report	1 Sep 1997
2.	General Report on Plant Status and Economy	1 Feb. 1998
3.	First Project Performance Evaluation Report (PPER)	1 Sep 1998
4.	Tripartite Review (TPR)	1 Oct 1998
5.	General Report on Plant Status and Economy	1 May 1999
6.	General Report on Plant Status and Economy	1 Sep 1999
7.	Second PPER	1 Sep 1999
8.	TPR	1 Oct 1999
9.	Independent midterm evaluation	1 Dec. 1999
10.	General Report on Plant Status and Economy	1 Sep 2000
11.	Project Terminal Report and Final Evaluation	1 Apr. 2001
12.	General Report on Plant Status and Economy	1 Apr. 2001
13.	Independent Evaluation	1 Apr. 2001
14.	Terminal PPER	1 Jun. 2001
15.	Terminal TPR	1 Jun. 2001

General Reports on Plant Status and Economy to be prepared by JBO and presented to GAM and JEA quarterly for the life of the Project.

ANNEX III.
TRAINING AND QUALIFICATIONS

A number of people will need to be trained not only to ensure proper operation of the biogas plant but also to ensure the correct dissemination of the results and to create the possibility of implementing replicable projects. The training should start with the training of the plant manager and technical operations workers. The qualifications of these persons are described below. Besides training of the plant manager and the technical operations workers, which should start very early in the construction period, training is suggested for the following institutions to improve the Jordanian infrastructure and produce the native basis of knowledge to support the current and replicable projects.

Targets for Training Activities (aside from plant personnel):

A. JBO

B. Laboratories of the Greater Amman Municipality (lab analysis for plant operation, quality control of the on-site measurements)

C. University of Jordan, Amman, Departments of Civil Engineering and Microbial Biotechnology (basic education for Jordanian university students, technical consulting on engineering and process operations at the plant, monitoring of plant's operational parameters and microbialogical aspects, both monitoring and basic research)

D. Managers of various major waste suppliers (for replicable projects).

F. NGOs (JES, QAF).

The overall training program will be based on:

- Training at international institute well-versed with biogas technology.

- Training at a Technical University.

- Training at an operational waste plant outside Jordan treating source-separated MSW, organic industrial waste and cow manure.

- Training at the Jordan Biogas Organization.

The intention is to implement a training program whereby the plant manager and the key technical operations personnel are trained. As soon as facilities exist in Amman, as much of the training as possible will be transferred to the plant. During the first one - two years of plant operation an experienced biogas plant operator or another qualified person will be located at the Amman biogas plant. With the direct involvement of the international consultants and plant contractors, he will supervise and assist the plant manager in order to ensure the best possible production of methane and thus carry out an on the job training that will enable the plant manager and the technical operations workers gradually to take over the operation during this period.

In addition, the plant manager, technical workers and JBO personnel will participate in a training program involving both theoretical and practical topics and exercises (theory and practical exercises and practical training at an already established plant).

The training program for the plant manager, technical-operational workers and JBO will include theoretical lessons on the following topics:

- Theory of methanogenesis in biogas reactors - the feeding chain, block-points and inhibitions and relations to various waste types, effects of special additions/additives (bleaching earth, GAC etc.), metabolite monitoring for process steering, etc.

- Metabolite measurements, gas production, biogas potential and specific activity measurements and measurement of other parameters for assessment of the state of the process and for process steering.

- The Bio-Waste Combined Organic Waste Treatment System - the salient points of the Bio-Waste System will be described and process management and steering will be discussed and analyzed with data from real plant operations.

The Plant Manager, technical operations workers and possibly University personnel will perform practical exercises covering measurement of the parameters to be used (total volatile fatty acid, ammonia, *p*H, alkalinity, volatile solids content, etc.) for process steering in order to familiarize the trainees with methods used for "at-plant" measurement. The University personnel will, in addition, receive training in the latest research methods for measurement of the same and other parameters (specific activity tests for microbiological assessment of the state of the microbiological catalyst, preparation of samples for specific and group immunofluorometric analysis, etc.), the goal being that the University will also be involved in basic consulting with respect to replicable projects.

As part of its mandate together with GAM, JEA, Ministry of Energy (MEMR) and the University, the plant will act as a Biogas Center with the goal of dissemination of renewable bioenergy technology in the Middle East. In this capacity, GAM, JEA and the University are charged with not only advisory scientific assessment of plant condition and operation on the process microbiology side, but also promotion of bioenergy education. In that respect, the personnel from these institutions will be trained abroad in state-of-the-art scientific methods and technology for research and assessment in the field of bioenergy and environment. All efforts will be made to establish a bioenergy center at the Amman Biogas Plant with its own in-house, self-reliant capability to identify, design and generate bioenergy technology and plans for the Jordanian situation. This will include training in evaluation of new wastes as potential biogas sources for replicable projects, training in the synthesis of waste treatment strategies given different and variable waste availability and treatment requirements, and training in basic biogas plant dimensioning and design.

All trainees who are sent abroad for diploma and degree training will sign the usual official contract to return to their jobs and undertake to work at least for twice the period of their training, but no less than two years.

University of Jordan and the JBO as a Biogas Technology Training Center for the Middle East

The biogas plant will, along with the UJ, become a center, the goal of which is the dissemination of renewable bioenergy technology in the Middle East. In this capacity the UJ and JBO is charged with not only advisory scientific assessment of the plant and operation on the process microbiology side, but also with promotion of bioenergy education. In that respect the UJ

personnel will be trained in Europe in state-of-the-art scientific methods and technology for research and assessment in the field of bioenergy and environment. The overall aim is to ensure the establishment of a long term and sustainable capacity to identify, design and generate bioenergy technology.

This will include training in evaluation of new waste streams for their potential as biogas sources for replicable projects, training in synthesis of waste treatment strategies given different and variable waste availability and treatment requirements, and training in basic biogas plant dimensioning and design.

In its role as a biogas research center, the UJ and the JBO will cooperate with the Takagas Center in Dar es Salaam established by the GEF/UNDP and DANIDA to promote biogas technology in East Africa. UJ and JBO will also be assisted in obtaining the ability to act as a training center for other organizations and institutions, including major waste suppliers interested in bioenergy technology.

ANNEX IV
EQUIPMENT REQUIREMENT

This Annex describes the details of the proposed biogas plant for treatment of organic municipal and industrial waste in Jordan. It includes the technical equipment for the plant. Further details will be added upon completion of design phase and following establishment of the identified two subcontracts.

THE DEMONSTRATION BIOGAS PLANT IN AMMAN

Design Basis and Mass Flow

The quantities of organic waste available are described in the PRIF study "Environment and Use of Methane from Municipal Waste". From that, a selection is chosen to form the optimal input for the demonstration plant. (The plant has a capacity of up to 60 tones a day, in the example below 51 tones are used).

Type	Amount (t/day)	Dry matter (t/day)	Volatile solids (t/day)
Segregated household waste	1	0.4	0.3
Expired food	5	2.1	2
Segregated hotel/restaurant waste	10	4	3.5
Vegetable market waste	10	4	3
Slaughterhouse waste *)	18	4	3.6
Chicken waste	5	3	0.8
Bleaching soil	2	1.95	0.7
Total	51	19.45	13.90

Waste composition of the demonstration plant, *) including blood waste. As will appear from the previous sections, the 51 tones can easily be increased, e.g. if a 2000 m^3 reactor is chosen.

From this input, the expected output is:

Biogas generated:	7,800 m^3 biogas/day
CH_4 generated:	5,200 m^3 CH_4/day
Electricity output (3.3 kWh/m^3 CH_4)	17,200 kWh/day
Internal use of electricity:	2,000 kWh/day
Electricity for sale:	15,200 kWh/day
Generation equivalent:	0.72 MW

An output of generation equivalent 1 MW can be accomplished at the biogas plant by increasing the reactor volume to 2000 m^3 or by changing the composition of feed so that the input contains more lipids. In this process 24,000 kWh/day can be available for sale. A reactor of 2,000 m^3 forms the basis of budget calculations.

System description of the biogas

Transport and pre-sorting

Waste will be transported to the plant, located at the same site as the current landfill, by the same trucks that normally deliver the waste to the current landfill.

The industrial organic waste is, in general, considered sufficiently free of foreign substances to be discharged directly into one of the three pre-storage tanks, dependent on the waste type, whereas household and market waste will contain small amounts of non-biodegradable and potentially contaminating matters, which will therefore require sorting. This will be carried out by discharging the waste on a concrete plate of **1,500 m²** at the receiving station. From this place, the degradable waste is loaded into the receiving tanks, whereas the undesired residues are disposed of at the dump site.

Pre-storage

Three parallel pre-storage tanks, 300 m^3 each, are chosen because some industrial waste, such as blood waste, is readily degraded with a high specific gas production compared with ordinary fruit and vegetable residues. Thus, the composition of the substrate to the digesters can be used for control of the gas production rate. A waste chopping system is included for maceration of the solid wastes.

In the pre-storage tanks, the waste is diluted with re-circulated liquid from the digested matter. The tanks are equipped with mixers to ensure that the solid waste is dissolved into the liquid to a homogeneous slurry in the tanks, with approximately 10-12% total solids (TS).

Digestion reactors

From the pre-storage tanks, the slurry is dosed into the two digester tanks with an active volume of 750/1000 m^3 each. To pump the slurry eccentric screw pumps are used. In the digester, the biomass is heated to approximately 55°C by heating coils. The necessary heat for the digesters is taken from the water cooling system of the gas engines. The digesters are completely stirred tank reactors with vertically mounted external mixers.

At the top of each digester, a gas outlet and safety equipment are mounted to control the pressure in the digesters.

Transport of Fertilizer

The solid residue is loaded into tank containers and collected by trucks from farms or plantations where the fertilizer will be used.

Gas Utilization

From the top of each digester, the gas is led through pipes and drained for condensate. A gas blower maintains an appropriate gas pressure at approx. 0.1 kPa in the digesters, and the gas is then led to a small low-pressure gas storage, to equalize hour-to-hour variations in production and consumption.

The gas will be fed into two gas engine generator sets, each of 500 kW electricity output. The generators are normally connected to the public grid, producing electricity both into the network and for the purpose of the plant (pumps, mixers etc.). In case of blackout of the public network, the plant is automatically disconnected and runs its own independent local network.

Technical description of the elements

Receiving station

The receiving station consists of a plate of the in-situ cast steel reinforced concrete, approx. 1500 m^2. In the concrete plate, a groove equipped with a screw conveyer is used to feed the waste into the receiving tanks. When household waste is discharged on the concrete plate, the non-biodegradable objects are removed and the rest is pushed into the groove.

Tanks

The tanks (pre-storage, digesters and the store for liquid) are made of in-situ cast steel reinforced concrete. The bottom of the tanks is approx. 1 meter below ground level. The concrete is reinforced with 120 kg. steel per m^3 of concrete.

Pre-storage

The pre-storage tanks are equipped with mixers which are able to produce a homogeneous slurry from waste and re-circulated liquid.

The mixers are mounted on the wall of the tank with the engine outside the tank. Nominal power consumption is approx. 50 kW. The mixers are controlled either manually or by a timer system, built into the switchboard.

The pre-storage tanks are each equipped with 2 pipes at the top for adding water and re-circulated liquid and 1 pipe at the bottom to pump out the slurry.

Digesters

The digesters are equipped with a mixer on a vertical axis, with gas-tight sealed bearings at the top. The gear and engine are mounted outside the tank. Nominal power consumption is approx. 10 kW.

In the lower third of the digester's height, a coil of steel pipe is mounted inside the tanks. Hot water from the gas engine's cooling system is pumped through the tubes. A thermostatic controller starts and stops the pump according to heating requirements.

The digesters are each equipped with 3 pipes: A gas outlet in the extreme top position of the tank, an inlet at the top and an outlet at the bottom of the tank.

To monitor the state inside the digesters, each is equipped with two manometers on pipe stubs, one for the gas pressure mounted at the top and one for detection of the liquid level mounted at the bottom.

Each digester is also equipped with 3 thermometer sleeves, one in the upper part and one in the lower part for thermometers, and the middle one for a temperature transmitter to control the heat added to the digester through the coil.

Storage for liquid

The tank is equipped with a submerged centrifugal pump. The pump is mounted on a guider rod, which makes it possible to inspect and repair the pump without emptying the tank. Power consumption is approx. 10 kW. The pump is controlled either manually or by a timer at the switchboard.

The tank is equipped with an inlet pipe at the top and an outlet from the pump.

Pumps

To pump the slurry from the pre-storage tanks to the digesters, and from the digesters eccentric screw pumps are used. The pumps are controlled manually or by timers at the switchboard.

Gas utilization unit

The gas system consists of gas pipes, a gas blower, a gas washer, and a cooler, low pressure gas storage and the gas engine/generator unit.

The gas blower is equipped with a frequency regulator controlled by pressure transmitters, mounted at the gas outlet of both digesters. The controller is built into the switchboard of the gas blower.

The gas is cooled in a gas/air heat exchanger, washed in a water spray and drained just before it is fed into the blower. The blower raises the pressure to 200 mbar and the gas is led to a gas storage tank.

A gas flare is connected to the gas dome to ensure safe handling of unused gas. The gas flare is controlled by a top level switch at the gas dome.

The gas engine/generator units are mounted with all necessary equipment for controlling etc. as turn-key packages, prepared to be controlled either by the applied load when disconnected from the network or controlled by the available gas in the dome, when connected to the network. If the public network voltage drops beyond a certain limit, the network is automatically disconnected. The generator output is at **11 kV** or more, and the internal power supply is made through a transformer. The unit is to be connected to an existing high voltage network.

Operational routines and staff

This section outlines the duties which have to be carried out by the staff in order to run the plant, and the necessary skills of the persons employed.

Receiving of waste

To ensure proper discharge of incoming waste and to sort out undesirable objects from the waste, **4** persons are required. In addition, they will be available for other tasks at the plant, including handling of fertilizer.

General maintenance

To carry out the regular service and minor repair work of mechanical equipment, **1** person is employed. A skilled worker in mechanics will be preferable.

Security guards

Security guards will be responsible for the safety of the plant premises. They will also be responsible for calling a standby technician in case of emergency situations at the plant. This facility could be shared with the landfill and the landfill gas facility.

Management

To manage the overall operation and development of plant and processes, a manager will be employed. The manager will be required to have experience and skills in planning and managing, and will be intensively trained during the first period of operation, in which the project still offers management support. During the first 2 years, the manager will be ensured

The system will automatically collect and store the measuring results for flow temperature, pressure, content of methane, carbon dioxide and oxygen. A security system is also connected to the system.

The system is installed in an MPR-module which is an abbreviation of Measuring, Pump and Regulation system. A computerized monitoring system will prove too expensive for the present pilot project. Renting will be considered.

Transmission gas pipe

From the pump house, the gas flows into the gas transmission pipe under pressure. This pipe follows the internal road approx. 700 meters from the point of utilization.

Utilization Plant

The proposal is to utilize the gas in a power production plant placed together with the biogas plant for organic waste at the entrance of the landfill.

The power plant unit consists of a gas engine linked to a generator which produces 500 kW of electricity. The utilization ratio of the energy supplied to the gas engine is approx. 32%.

The engine will be equipped with an air cooling system. Unfortunately, there are no users for the waste heat in the vicinity, but if this should change in the future the heat can be supplied at a very affordable rate.

The landfill gas is expected to produce 300-500 kW. During the implementation, attempts will be made to take advantage of this gas by feeding it to a separate 300 kW engine which would work alongside the two 500 kW gas engines operating on biofuel.

ANNEX V

Economy of the plant and assurance of replicability

In accordance with the economic evaluation done by biogas experts the annual income and expenditure are evaluated to be:

Annual expenditure

Maintenance: 3% of the cost of investment	USD 2.5 million	USD 75,000
Operations	USD 50.000	
Sundries	USD 38,000	
Total	USD 163.000	

Income

Sale of electricity 7.2 million kWh at 4.7 cents =USD 338,000

Gross profit	USD 175,000
Set aside for replicable projects	USD 100,000
Net profit	USD 75,000

In addition, income from the sale of fertilizer may be expected. As this is a new product (waste fertilizer) it will, however, take at least 2 years before a market for this type of fertilizer is created.

ASSURANCE OF REPLICABILITY

(Demonstration Plant)

The average production price of the proposed combined biogas - landfill plant is calculated to be US 5.6 cents/kWh. This price is slightly higher than Jordan Electric Authority's (JEA) Long-Run Marginal Cost of generation (LRMC) of 4.7 US cents/kWh. However, considering the environmental advantages associated with a project of this type (prevention of contamination of water basins, reduction of landfill disposal problems such as smells, vermin and disease spreading), it is foreseen that these beneficial externalities should over-weigh the extra production cost and the Government of Jordan will therefore promote the technology after all relevant barriers have been removed. Apart from that, it should be noted that if a larger plant is constructed or if the capacity of the current plant is expanded, then the capital cost (investment) per kW will be lower resulting in an average production cost for the plant which will likely fall below JEA's LRMC making this type of plant as cost recoverable as an avoided conventional fossil fuel plant. This is even excluding the possible profits earned through sale of residue fertilizer and of course the above mentioned environmental benefits. These factors considered would make replication all the more attractive.
A detailed calculation of the plant's power production price is shown below.

Annual operation cost: Total $ US 163,000

Electricity production:

1000 kW x 8000 hours = 8,000,000 kWh

Average generation cost:

$ US 163,000 / 8,000,000 kWh = 2.0 cents/kWh

Annual investment cost (Annual capital charge):

Investment per kW:

USD 2.5 million / 1000 kW = $ US 2500 per kW

Amortizing over 15 years with 8%
(discount rate):

Annual Amortization Charge = 0.116

Annual capital cost per kW:

2500 $/kW x 0.116 = USD 290 per kW

Electricity production per kW installed per annum is 8000 kWh.

Capital charges will be:

290 $/kW divided by 8000 kW/kWh = 3.6 cents per kWh

Total production price:

Annual operation cost	2.0 cents per kWh
Annual capital charge	3.6 cents per kWh
Total Price	**5.6 cents per kWh**

ANNEX VI

Proposed Input to Joint-Venture Agreement to Establish a Jordanian Biogas Based Electric Power Generating Organization (JBO).

The two parties mentioned agree to enter into an agreement for the benefit of the Hashemite Kingdom of Jordan as well as their mutual benefit.

The First Party to this agreement is the Greater Amman Municipality and the Second Party to this agreement is the Jordan Electricity Authority. A detailed description of the project can be found in the feasibility study dated 8-8-93 and the project brief by UNDP of April 96.

Background:

This agreement is established in the framework of the UNDP - GEF project: "Reduction of Methane Emissions and Utilization of Municipal Waste for Energy In Amman" to enable the two parties to manage the activities in the above mentioned project thereby establishing a facility to generate electric power from methane produced and extracted from Municipal Solid Waste.

Purpose:

The purpose of the agreement is to clarify the division of Responsibilities, Duties, Necessary Inputs and Division of Benefit between the above mentioned parties for the duration of the above mentioned project.

Responsibilities and Inputs:

The first party, The Greater Amman Municipality (here-after referred to as GAM), will have the following responsibilities and duties (and will manage the following activities) as support to JBO:

Collection, and sorting of the Municipal solid Waste.
Transportation of high organic waste to the Biogas reactor.

Providing the Methane gas for combustion in the Gas engines.
Management and sale of residue fertilizer.

The GAM will provide the following inputs for project initiation:
The site and location of project execution.
Roads, fence and structural foundation for the biogas reactor.
Preparation of site. Provision of necessary infrastructure.

The Second Party, Jordan Electricity Authority (here-after referred to as JEA), will have the following Responsibilities and duties:

Production of electric power from methane gas in gas engines.
Managing and maintaining the connection of the plant to the national Power grid.
Sale of excess electric power produced to tne public.
Operate, maintain and manage the power generating facility.

The JEA will provide the following inputs for project:
Supply the grid connection from the generators to the national power grid.

Cooperation during construction

GAM and JEA will each appoint an officer as contact person during construction. The construction work is expected to be carried out on a turnkey basis with the contractor doing the detailed design and the construction. This contractor will be given the responsibility to guarantee the methane production and the obligation to use as much local companies as possible. The tender documents will be prepared jointly by GAM and JEA based on input from UNDP and the assistance of an external consultant on issues where JEA and GAM have no expertise. This consultant should also assist when needed during construction and commissioning.

Organization

Both parties will jointly appoint a plant manager who will undertake the day to day management including employing the necessary staff for running the plant,

maintenance and financial issues relating to the plant. The plant will run as an economic separate unit with an annual statement of income and expenditures.

Financial issues

The plant will generate income after commissioning from the sale of electricity and fertilizer. This income will be used for salary to the plant manager and plant staff, maintenance and other operation costs. The remaining income will be divided equally between GAM and JEA

Replicable projects

The generated surplus income, which is expected to be about USD 150,000 annually, will be invested by JEA and GAM in replicable projects and/or expansion of the demonstration plant.

Disagreements

Any disagreement arising from this Joint-Venture agreement must be settled by the Ministry of Planning which can consult with UNDP for clarification on issues relating to UNDP policy and strategy.

Additions and changes to the Joint Venture Agreement

Any addition and changes to the agreement must be approved by the Ministry of Planning and UNDP if the need for changes arises during project execution.

Date

---	---
Greater Amman Municipality	Jordan Electricity Authority

ANNEX VII

Detailed budget estimate for equipment to be procured

Biogas Plant:

2 reactor tanks, 1000 m^3 = 2000 m^3	500,000
2 mixer systems:	165,000
Installation:	20,000
Pipes, fittings and valves:	50,000
2 heating systems:	70,000
Subtotal:	**805,000**
2 storage tanks with lids, 300 m^3	40,000
2 mixer systems	30,000
Maceration systems	30,000
Pipes and fittings	10,000
Subtotal:	**110,000**
1 steel storage tank 300 m^3	20,000
1 mixer system	10,000
Pipes and fittings	10,000
Installation	10,000
Subtotal:	**50.000**
1 storage tank for digested material, 2000 m^3	120,000
2 mixer systems:	20,000
1 lid for storage tank	10,000
1 gas system	15,000
Pipes and fittings	10,000
Installation	15,000
Subtotal:	**190,000**

Pumps	35,000
Valves	20,000
Pipes, valves and fittings	20,000
Installation	30,000
Unforeseen expenses	25,000
Subtotal:	**130,000**
Gas System	
Gas blower	25,000
Valves and measurement equipment	20,000
Flare and gas	35,000
Pipes and installation	50,000
Subtotal:	**130,000**
Heating System	
Pumps	10,000
Pipes, fittings and valves	20,000
Sensors and measurement equipment	20,000
Installation	30,000
Subtotal:	**80,000**
Laboratory equipment	50,000
Monitoring and regulation system	65,000
Drawings, projecting and conducting	150,000
Subtotal:	**265,000**
Total, Biogas plant:	**1,760,000**

Power Generation System

2 Gas engines 2 x 500 kW = 1 MW	700,000
Subtotal:	**700,000**
Total, Power Generation System:	**700,000**

Landfill Gas System

Extraction System

10 wells	60,000
Pipes and fittings	30,000
Subtotal:	**90,000**

Pump Container

Container with pump, coiling and manual regulation fittings	100,000

Gas Transmission pipe

1000 m pipeline	40.000

Projecting/Conducting

Projecting, conducting, travel	90,000

Total, Landfill Gas System:	**320,000**

ANNEX VIII

Terms of Reference for the Administrative Director

The overall implementation of the project will be overseen by an Administrative Director who will be appointed by the Government in consultation with UNDP.

The Administrative Director will be charged with coordinating and acquiring information from the task managers associated with different tasks within the information/capacity component of the project and the plant construction/operation component of the project. The Administrative Director will organize the acquired information so that it is made readily available to the responsible task managers who need to coordinate their activities with those of other project tasks. Moreover, the Administrative Director will bring together a quarterly progress report based on the information acquired from the different project tasks. This report will be sent to the UNDP, the Ministry of Planning and the Regional GEF Coordinator in New York.

In matters concerning the capacity and information component of the project the Administrative Director will coordinate with and report to the SCC. On the other hand, in matters concerning the operation and construction of the biogas plant the Administrative Director will coordinate with and report to the plant manager

ANNEX IX

Terms of Reference for the Project Initiation Consultant

Qualifications

University level degree in an area related to bio-methanization processes and/or the design and analysis of micro-biological (especially aerobic) processes .

The consultant will have worked extensively (at least 10 years experience) with anaerobic process and landfilling technology which includes experience with the production of methane gas.

The consultant will also have experience with waste management issues. Knowledge of handling, treatment, collection and separation of the waste is important for the consultant to be able to perform his/her duties fully.

Specifically the consultant will have experience within:

- microbiology
- biomass evaluation and energy potential
- process description and process inhibition
- dimensioning
- parameters of regulation
- reactor design and choice of design
- controlled and sanitary landfilling
- waste management
- operations of biogas plants and landfilling operations that generate methane gas.

The consultant will have experience with work of a long duration in developing countries and should be familiar with the common problems of project initiation in relevant settings.

Tasks:

A. Work in close cooperation with the SCC to initiate the project.
B. Prepare a detailed inception report.

C. Develop and start the implementation of a detailed work plan for the project.
D. Assist in the selection of the project's Administrative Director (together with the Government Executing Agency and UNDP)
E. Advise the Government and UNDP on project implementation.
F. Prepare job descriptions for all senior Government staff to be assigned to the project.
G. Prepare tender documents for plant design and training packages.
H. Finalize the framework of JBO and assist it in starting its functions.
I. Manage the project on a day-to day basis in the initiation period.
J. Undertake regional and global contacts and communications that will serve the purpose of the project.

The assignment for this consultancy is for a duration of 6 consecutive months at project start-up.

ANNEX X

CALCULATION OF INCREMENTAL COSTS

Broad Developmental Goals

1. With a growing economy, Jordan's demand for electricity increased rapidly. Moreover, with the recent peace accord, investments are rapidly increasing, and the demand for power is increasing accordingly. As the tourism and hotel infrastructure expands, not only will the demand for power grow, but also the streams of municipal solid waste.

2. In view of Jordan's limited indigenous resources of energy, Jordan takes renewable energy activities very seriously. Active investment and experimentation have therefore been done in the wind and solar fields, but the initial investments and the price of the electricity produced have been too expensive and not competitive.

Baseline

3. Jordan, and especially Amman, has experienced a rapid population growth (Jordan's present population growth is 3.5 % annually) during the last five years. This has partly been caused by natural population increase, partly by the return of many expatriates during the Kuwait invasion and partly caused by the boom which is being created by the peace accord. Amman is thus growing at a rate of nearly 5% annually. Zerqa, including its suburbs to the north-east of Amman is experiencing a similar growth and expansion rate. The municipalities of Amman and Zerqa share the same municipal landfill. Annual MSW collections amount to over 0.7 million tones of MSW (approximately 1,900 tones daily). At the present growth rates, by year 2,000 waste collection in the two urban areas will exceed 2,300 tones daily. Based on an estimated annual emission of CH_4 and CO_2 in Jordan of 120,000 tones (166 million m3) and 12 million tones respectively, the implementation of biogas and landfill gas technology in Jordan has the potential of a reduction of the total CH_4 emission by 33.4 % and of the total CO_2 emission by 2.2%.

4. Electricity production in Jordan in 1995 amounted to 5600 GWh (5.616 million kWh). The average annual per capita consumption is about 1400 kWh and the demand is rising rapidly. Electricity consumption by sectors is as follows:

Industrial	:	35%
Domestic	:	30%
Commercial	:	11%
Water pumping	:	18%
Others	:	6%

5. The electricity demand increased in 1995 by over 10.5% compared to 1994 figures and the rise has been steady. Based on projections, it is envisaged that electricity demand in the year 2000 would be at least 60% higher than in 1995.

Global Environmental Objective

6. The global environmental objective being pursued is the reduction of GHG emissions through this demonstration project by (i) capturing of GHG emissions from an established landfill, (ii) further reducing future landfill emissions, by introducing a biogas reactor system which will capture parts of the biodegradable waste that would otherwise have gone to the landfill and (iii) providing an alternative energy source to carbon based fuels in the form of methane gas produced from the combined landfill/biogas reactor system.

7. As such, this project has been designed to correspond to **GEF Climate Change Operational Programme #6: "Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs".**

GEF Alternative

8. As described in the GEF Project Brief, endorsed by the GEF Executive Council in April 1996, the different Objectives of the project will all focus on removing different barriers to the effective introduction, adoption and replication of this type of renewable energy source. The Feasibility Study carried out for the preparation of the present project confirmed the technical feasibility (waste streams, human and resource capacity, MSW handling and operation, landfill management, competitive pricing situation, excellent demonstration conditions, existence of interested investment partners and local community interest) of the present project.

9. Three main barriers have thus been identified which will need to be overcome to successfully introduce this technology in the Jordan and sub-regional setting. Objective 1 of the project addresses the technology barrier. In Jordan, there is an urgent need to establish the demonstration plant as the actual "seeing is believing" is probably the most important barrier to be overcome among policy makers, investors and technicians. An operational biogas plant would provide an excellent spring-board for subsequent investments in the sub-region. In view of the key role which Jordan is already beginning to play in the sub-region following the peace accord, this is indeed a most significant contribution which the GEF will be making. Jordan is the ideal location for this demonstration plant in view of its excellent municipal waste collection and management systems. However, in view of the enormous waste and energy problems which are presently facing the Palestinian territories, Lebanon in the sub-region as well as Egypt, Tunisia and Morocco in the Arab world, this plant has an enormous capacity for being the main catalyst which could lead to subsequent repeater investments in other countries.

10. Objective 2 of the project addresses the capacity barrier which the country is currently facing. While Jordan is a country with very highly educated and dedicated technicians at the

graduate and postgraduate levels, these is not in Jordan at present an experience or full understanding among technicians of the possibilities offered by the bioenergy option. This is largely due to lack of exposure to the technology and the present project has been designed specifically to help overcome this barrier. This will enable Jordan to become a center of knowledge in this field, with active outreach and demonstration capacity not only to investors based in Jordan also to investors from the countries in the subregion which are also dependent on oil imports.

11. Objective 3 of the project addresses Information Barriers: lack of information on technology, lack of data on in-country biogas potential and need to strengthen popular involvement in household-based MSW management issues. Activities under this objective have been designed specifically to meet and help overcome these barriers.

12. There are significant global benefits to be achieved as a result of this project. Calculations shown in Annex 4 of the Project Brief demonstrate that there is a potential GHG reduction of 382,400 tones of CO_2 which can be avoided based on a 10-year scenario. If a subsequent follow-on investment were projected the GHG emission reduction scenario would be clearly be even more attractive.

Costs

13. The costs of this project are estimated to be $ 5.319 million, of which $ 2.5 is being requested from GEF. The Jordanian government has agreed to provide a cash contribution of $700,000 to ensure the grid connection and $ 619,000 equivalent. In addition, the UNDP is in discussion with the Government of Denmark and UNDP has received a commitment of a grant of $ 1.5 million for this project.

14. A detailed Indicative Budget which includes an Incremental Cost summary follows.

Indicative Budget and Incremental Cost Summary

Component	Staff Costs ($000)	Sub-contracts ($000)	Equipment Costs ($000)	Training ($000)	Misc. ($000)	Total Costs ($000)	Transaction Barrier	Likely Incremental Costs	How will Replication be assured?
1. Information and outreach							Lack of info., scientific skills and experience with advanced bioenergy techniques Lack of Master Plan for Bioenergy in Jordan	Positive	Detailed knowledge on MSW constituents and disposal in Jordan will allow for planning of further downstream investment in the biogas field. An informed public as well as policy makers will facilitate greater receptivity to this new form of energy.
1.1 Study of MSW in MGA: quantity, constituents, dumping, disposal & segregation.	10	40	0	0	0	50			
1.2 Estimate emissions & impact from present MSW.	10	20	0	0	0	30			
1.3 Introduce & implement methods of handling.	10	40	0	20	0	70			
1.4 Finalize designs to utilize MSW as an energy source in MGA.	0	40	0	0	0	40			
1.5 Inform policy makers, intellectuals & media on technological choices available in Jordan for energy from hydrocarbon alternatives.	45	0	0	0	0	45			
1.6 Involvement of NGOs in outreach work.	40	20	0	0	0	60			
GEF Contribution	115	160	0	20	0	295			
Other Contribution	0	0	0	0	0	0			
SUM	115	160	0	20	0	295			

2. Training and technical upgrading 2.1 Training of technicians in technical choices & possibilities of bioenergy.	50	50	0	160	25	305	Lack of technical know-how for bioenergy design and operation Lack of replication ability.	Positive	The existence of well-trained technical cadres and managers as well as decision-makers will facilitate the commercial replication of the technology.
2.2 Upgrading of capacity at MGA, JEA & JBC personnel re. know-how.	40	40	10	40	10	140			
2.3 Establish twinning arrangements bet. UJ and bioenergy specialists.	10	10	40	30	10	70			
GEF Contribution	100	90	50	230	45	515			
Other Contribution	0	0	0	0	0	0			
	100	90	50	230	45	515			

3. Demonstration plant 3.1 Construction & start-up of combined plant.	310	0	2500	160	0	2970	Lack of ability to create demonstration facility which will enable subsequent duplication Lack of investor confidence without demo plant.	Positive	See Annex V
3.2 Preparation of detailed plan for collection & transport of MSW.	0	40	0	0	0	40			
3.3 Optimize composition of waste & elaborate on plan collection of waste.	0	40	0	0	0	40			
3.4 Preparation of master plan for bioenergy in Jordan.	0	40	0	0	0	40			
3.5 Establish small outreach :enter.	25	0	10	10	5	50			
3.6 Design least cost future investment program for utilization of MSW as an energy source.	0	50	0	0	0	50			
GEF Contribution	335	0	1180	170	5	1690			
Other Contribution	0	170	1330	0	0	1500			
SUM	335	170	2510	170	5	3190			
Total GEF	550	250	1230	420	50	2500			
Total Other	0	170	1330	0	0	1500			
Grand Total	550	420	2560	420	50	4000			
Jordan's contribution (Grid Connection only)			700			700			

GEF INCREMENTAL COST MATRIX

Component	Cost Category	Cost (US$)	Domestic Benefit	Global Environmental Benefit
Component 1: Information and outreach.	Baseline	0	Continued lack of popular involvement in issues pertaining to waste management and continued lack of understanding for potential of MSW in power generation.	Continued dismissal of biomethanization and landfill extraction of MSW as a potential source of renewable energy by both the population and policy makers in Jordan.
	Project	US$295,000	Extensive outreach to population and policy makers on issues pertaining to MSW and its potential as a renewable source of energy.	An informed and aware population and decision makers on issues pertaining to the potential of MSW as a biofuel.
	Increment	US $ 295,000 (GEF)	Extensive outreach to population and policy makers on issues pertaining to MSW and its potential as a renewable source of energy.	An informed and aware population and decision makers on issues pertaining to the potential of MSW as a biofuel.
Component 2: Training and technical upgrading	Baseline	0	Continued lack of know-how on design and management of biogas technology and a continued lack involvement of the scientific community in field of bioenergy.	Continued lack of ability to design, implement and manage biogas technology and estimate its potential. Further, continued limited involvement of scientific community in Jordan in this field.
	Project	US$515,000	The creation of a strong national capacity in MGA, UJ and JEA. Moreover, the creation of a strong and able institution (JBO) capable of advancing bioenergy.	The existence of a capable cadres, trained in technical and managerial issues, will ensure that the technology and the accompanying global benefits are sustainable and replicable.
	Increment	US$515,000 (GEF)	The creation of a strong national capacity in MGA, UJ and JEA. Moreover, the creation of a strong and able institution (JBO) capable of advancing bioenergy	The existence of a capable cadres, trained in technical and managerial issues, will ensure that the technology and the accompanying global benefits are sustainable and replicable.
Component 3: Demonstration Plant	Baseline	US$700,000 (in-cash) US$619,000 (in-kind)	Continued demand for the demonstration of biogas technology as a viable and sustainable source of energy.	Continued and growing dependency on imported fossil fuels foe generation of electricity. Moreover, emissions from MSW would continue to grow without any prospects of controlling this growth.
	Project	US$3,190,000 (GEF and DANIDA)	Demonstration of a technology that potentially over the long term could substitute expensive imported fossil fuel with a sustainable local energy resource. This technology would also resolve growing solid waste disposal problems, would reduce contamination of ground water basins and would supply the country with valuable soil conditioner.	A reduction of 382,400 tons of CO_2 by the tenth year of plant operation. Replication could potentially achieve a reduction of 0.5 million tons of CO_2 annually from landfill and biogas technology. This figure would increase drastically when the impact of fuel substitution is taken into account.
	Increment	US$1,690,000 (GEF) US$1,500,000 (Denmark)	The erection of a 1 MW demonstration plant utilizing MSW for production and extraction of methane gas to be used as fuel in a gas engine.	A reduction of 382,400 tons of CO_2 by the tenth year of plant operation followed by 38,240 tons of CO_2 equivalent per additional year of plant operation.
Totals	Baseline	US$1,319,000		
	Project	US$5,319,000		
	Increment	US$4,000,000 (2.500,000-GEF) (1,500,000-DEN)	Removal of barriers to the adoption of biofuel from landfilling and biomethenization as a sustainable local sources of energy in Jordan..	382,400 tons of CO_2 by the tenth year of plant operation and 38,240 tons of CO_2 equivalent per additional year. Replication could achieve a reduction of 0.5 million tons of CO_2 annually from the same technology. This figure would increase drastically if impact of fuel substitution is taken into account.

LETTER OF COUNTRY ENDORSEMENT BY DESIGNATED OPERATIONAL FOCAL POINT

بسم الله الرحمن الرحيم

THE HASHEMITE KINGDOM OF JORDAN
MINISTRY OF PLANNING
AMMAN

المملكة الأردنية الهاشمية
وزارة التخطيط
عمان

Ref: 1/1/6330
13/11/1994

الرقم
التاريخ
الموافق

H.E. Osman Hashim
Resident Representative
UNDP
Amman, Jordan

Excellency,

Subject: Reduction of Methane Emissions and Utilization of Municipal Wastes for Energy in Amman

I wish to refer to the above GEF project proposal and to iterate the importance of this project to the Government of Jordan in protecting the global environment and would therefore appreciate your kind assistance in securing GEF funding for this vital project.

Also, I would appreciate your assistance in submitting this proposal to the GEF Executive Council for favorable review and consideration for funding during the first and/or second tranches.

Thanking you for your cooperation in this matter.

Sincerely yours,

Hisham Khatib
Minister of Planning

صندوق بريد : ٥٥٥ العنوان البرقي : NPC - تلكس : NPC ٢١٣١٩ جو . MINP ٢٤٢٥٨ جو فاكسيملي : ٦٤٩٣٤١ - تلفون : ٦٤٤٤٦٦ / ٧٠ - ٦٤٤٣٨١ / ٨٥
P.O.Box : 555 Cable : NPC Telex : 21319 NPC Jo, 24258 MINP Jo Telfax : 649341 - Tel. : 644466/70 - 644381/85