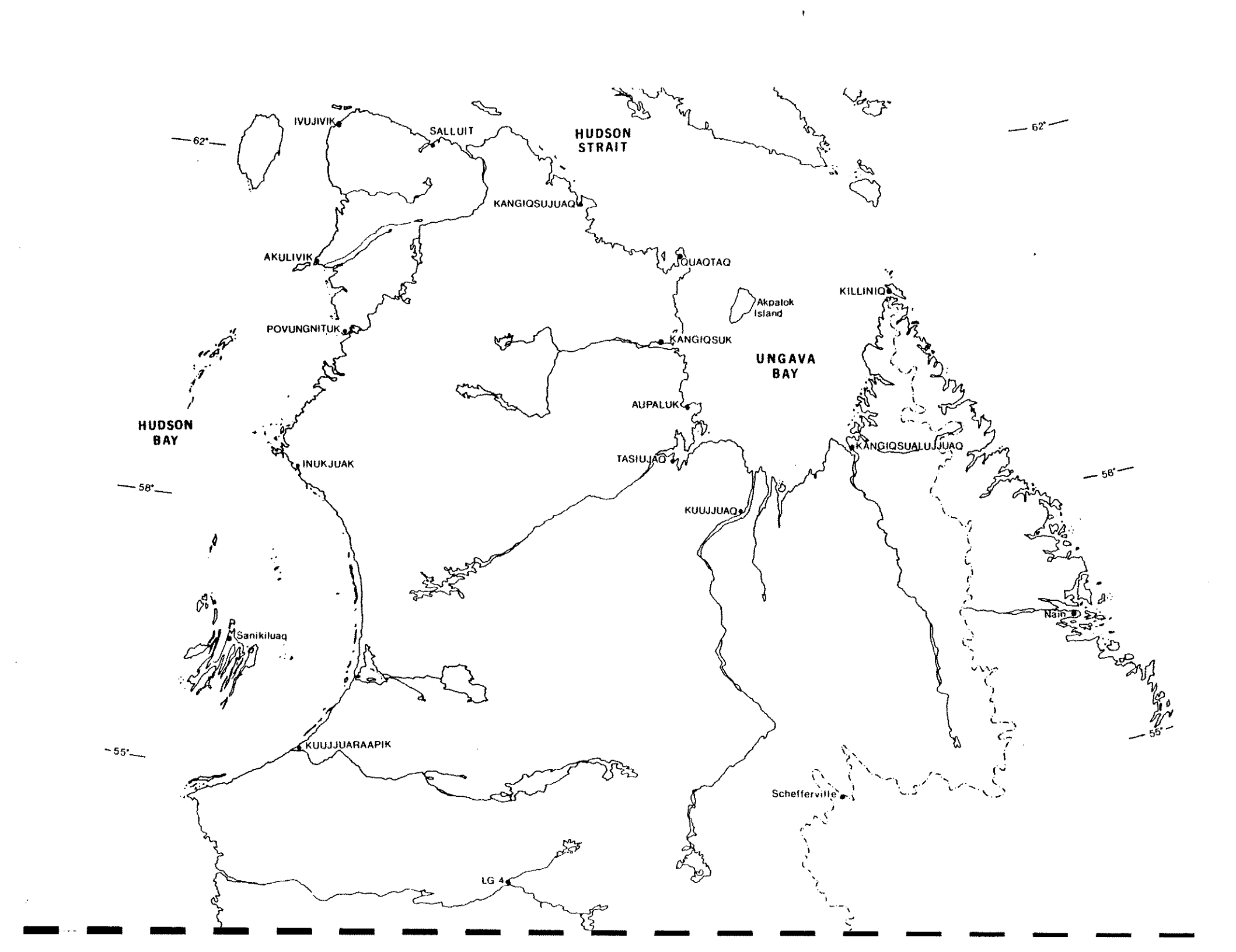
PROPOSAL FOR AN ENERGY PLANNING AND DEMONSTRATION PROJECT FOR NORTHERN QUEBEC UNDER PHASE I AND II OF THE REMOTE COMMUNITY DEMONSTRATION PROGRAM ENERGY, MINES & RESOURCES, CANADA

Joint Submission by:

Kativik Regional Government
Makivik Corporation

April, 1983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1. BACKGROUND

The present proposal is a joint effort of the Kativik Regional Government and Makivik.

The Kativik Regional Government is a regional government created under Québec law in 1978 with jurisdiction and responsibility for administration of the Territory north of the 55th parallel in Québec and the fourteen permanent Inuit communities in that region. These communities are scattered along the Hudson Bay, Hudson Strait and Ungava Bay coasts in northern Québec, each having a population of somewhere between 100 and 1200 inhabitants. None of these communities are connected to any central grid electrical supply or natural gas supply, nor is there any firm commitment at the present time to connect these communities to such power supplies. These communities presently depend entirely on liquid hydrocarbons for all of their energy needs.

Makivik is an Inuit association created under Québec law in 1978. Its membership is composed solely of Inuit beneficiaries under the James Bay and Northern Québec Agreement signed in 1975. Makivik has the legal responsibility to implement and protect the various rights and benefits of Inuit under the Agreement. In addition, its objects provide in part that:

> «5(b) to relieve poverty and to promote the welfare and the advancement of education of the Inuit;
>
> (c) to develop and improve the Inuit communities and to improve their means of action;
>
> (e) to foster, promote, protect and assist in preserving the Inuit way of life, values and traditions.»

1.1 Statement of Intent

The federal department of Energy, Mines and Resources, as part of the National Energy Program, has established an assistance

program to promote energy supply and conservation alternatives in remote communities. This program is known as the Remote Community Demonstration Program (R.C.D.P.).

The present proposal is in response to the above Program and is designed to accomplish the following in regard to alternate energy and energy conservation measures in northern Québec communities with a view to:

a) generating a meaningful data base with respect to these matters for communities in northern Québec north of the 55th parallel;

b) undertaking community energy planning and conservation studies; and

c) providing both the Inuit communities and the region as a whole with specific recommendations as to energy conservation and alternative energy measures and options available to them; and

d) undertaking of various demonstration projects to implement these recommendations.

Fundamental to the implementation of the present proposal is the meaningful participation of Inuit in the management, training and benefits, both short-term and long-term, of the proposal.

1.2 Summary of Approach

The present proposal outlines a series of detailed energy planning activities in two pilot communities in the Region north of the 55th parallel in Québec which will establish a basis for energy planning across the fourteen communities in northern Québec.

As it presently exists, the Remote Community Demonstration Project (R.C.D.P.) is a two-phase program: Phase I relates primarily to research and Phase II relates to actual demonstration projects.

With respect to phase I, the present proposal provides for research, studies and training leading to community energy planning on a regional basis as well as some limited demonstration project activities in two pilot communities. With respect to Phase II, the present proposal provides for a list of possible energy technologies available for demonstration projects in the various communities of northern Québec. It is clear that the design, development and installation of one or more of the major renewable energy demonstration projects in phase II will depend directly upon the results of the phase II studies and evaluations of energy demand, resources, options and impacts.

More specifically, this study proposes as part of Phase I, the development of both primary and secondary information bases. The development of these information bases will involve a survey of existing data, modest experiments in the field, engineering calculations and studies, and various interviews with the local inhabitants of the region.

With respect to the creation of energy plans for the two pilot communities, this will be undertaken in five main steps as follows: a) the tabulation of present energy consumption levels in those communities; b) the projection of future energy consumption in those communities; c) the projection of potential energy savings through conservation measures in those communities; d) the projection of renewable energy development programs for those communities; and e) the development of specific implementation plans for those communities. It should be noted that though the Energy, Mines & Resources, Canada information with respect to its R.C.D.P. program makes a distinction between Phase I and Phase II of its program along study/demonstration lines, the present proposal suggests that some study activity and some demonstration activity should take place simultaneously in both Phases of the R.C.D.P. program.

The present proposal also recognizes the vital importance of training of local inhabitants for the design, implementation, maintenance and continuity of use of information and technology generated during and following the present project. Phase I of the project deals with the initial field and demonstration studies aimed at identifying areas suitable for further research and implementation of energy conserving or alternate energy systems. Because this is the exploratory phase of the project, training and demonstration will be limited to the two pilot communities and will involve the development of a Community Energy Specialist Training Program which, if successful, can later be instructive for the development of similar programs in other communities.

2. TECHNICAL PROPOSAL

2.1 Energy Planning

The energy planning activities proposed in Phase I of this project will establish a basis for energy planning across the fourteen communities in northern Québec. In addition, a replicable community energy planning process will be developed and implemented in two pilot communities. Replicability for other remote northern communities will be stressed in every aspect of the energy planning process.

2.1.1 Development of Information Base

Energy planning for the Inuit communities of northern Québec must begin with a very complete picture of energy use and resource availability in the region. This «picture» must be accurate in regard to the present and as accurate as possible in regard to the future. An information base for planning must also include selected information on energy technology options, including cost, performance, maintenance requirements, durability, safety, availability, environmental impact, potential social consequences and effects on employment. Once this information is gathered, analyzed and shared with the population, a participatory community energy planning process can take place, leading to the development of a community energy plan. Specific topics to be included in the information base are as follows:

(a) Information on similar initiatives and projects - Full benefit should be taken of experience gained and conclusions of similar initiatives and projects in remote communities in Canada and elsewhere. What has and has not worked in the past will provide important input to planning for the northern Québec energy planning and demonstration

project. Information regarding the plans and experiences of other communities in the Remote Community Demonstration Program will be solicited (and reciprocated) throughout the duration of the project.

(b) Data on energy use in the region - This will be both regional and on a community-by-community basis. It will include historical and current data, as well as future projections made by various sources. All energy usage data will be tabulated in a matrix where it is disaggregated by end-use:

- transportation (air, land, water)
- space heating (residential, commerical, public)
- lighting (residential, commercial, public)
- water heating (residential, commercial, public)
- home appliances
- commercial activities equipment
- public works equipment
- communications equipment.

The past and present type and quantity of fuels to meet each of these end-uses will be identified separately wherever possible. Total fuel use by type will also be tabulated, separated into:

- total fuel oil consumed (volume and grade)
- total gasoline consumed (volume)
- total other fuels consumed (volume and type)
- total electrical consumption (volume).

Additionally, this section of the data base will include information on:

- cost of each type of fuel (with and without subsidies)
- size of electrical generators, base and peak loads
- population and growth
- number, size and characteristics of buildings.

(c) Data on energy resources in the region - This will include all information on presently known and potential energy resources in Québec north of the 55th parallel, including:

- fossil fuels
- hydro energy
- tidal energy
- wind energy
- solar energy

Information will primarily concern resource availability, including:

- location (relative to communities) and accessibility
- magnitude and density of the resource
- variability of the resource
- preliminary feasibility of utilization

(d) Information on renewable energy and energy conservation technologies - Where possible, this information will relate to the use of these technologies in environments where there are similarities to the communities and envirionment of northern Québec. General technical data and study results will also be included. Specific topics to be addressed will be:

- experience in the past
- performance over time

- employment impact (local manufacturing, installation and/or operation)
- design and engineering requirements
- operation requirements
- maintenance requirements
- reliability and durability
- risk
- availability of materials or equipment.

(e) Energy technology impacts - Specific information is needed on the health, safety, social and environmental impacts of candidate energy conservation and renewable energy technologies, as well as the energy systems already in use. Both positive and negative impacts will be included and used to assess energy options available to the communities in the region. Examples of the types of impact information necessary include:

- impact on air quality of energy generation combustion products
- impact on water quality of energy generation waste materials and waste heat
- impact on health of high or low temperatures and humidity in buildings
- impact on health of poor indoor air quality
- relative safety associated with the installation and operation of various energy conservation and renewable energy systems
- impact on wildlife due to construction and/or operation of new energy facilities
- impact of energy technologies on Inuit culture and harvesting activities.

The process for developing this information base is described in the subsections below.

2.1.1.1 Survey of Exisiting Information

The first step in developing the information base described above will be to survey and acquire relevant existing information. Information in each of the areas listed above will first be sought from the files and personnel of Kativik Regional Government and Makivik Corporation. Full use will be made of the Makivik Research Department, and the various in-house resources of the Kativik Regional Government.

Subsequently, relevant information will be solicited from appropriate Québec (S.H.Q., Hydro-Québec, Ministry of Energy) and federal (E.M.R., D.I.A.N.D., N.R.C., C.M.H.C.) sources. It will be particularly important to acquire information from and about other remote northern communities, in the Northwest Territories, Yukon, Alaska and Greenland. A selective literature search will be conducted and information sought from key academic and research institutions.

2.1.1.2 Identifying Gaps

Once the «existing information» base has been assembled, it will be evaluated to identify important gaps. The critical information needed to conduct adequate energy planning at the community level will be compared against the «existing information» to determine what information is still needed.

The list of needed information will then be evaluated and prioritized. Some information may be too difficult, expensive or time-consuming to acquire. Some will be deemed to be not critical. From this process, a list of information remaining to be acquired in the field or from research studies will be developed.

2.1.1.3 Gathering or Development of Missing Information

As part of this project, base-line information will be gathered in the field only to fill identified critical gaps in the information base. The procedures used to gather this information will depend on the types of information needed and where it is found.

Missing data on energy use in the region which it may be necessary to gather as part of this activity would probably be limited to current usage. Should aspects or details of the usage data for a community not be adqeuate, if necessary, project personnel will gather this information by visiting the community. Survey methods could be used to gather such information. For example:

- an updated or more detailed survey of building characteristics
- an inventory of oil burning equipment to assist in disaggregating oil consumption by end-use and aid in calculation of end-use energy requirements
- an inventory of all equipment using electricity (applicances, lighting, communications, public works, and so on) to assist in disaggregating electrical consumption by end-use
- a survey of energy use in the transportation sector.

Missing data on energy resources in the region will similarly be collected in the field, as necessary. Where long-term direct measurement of resource availability is not justifiable or feasible, short-term or periodic measurements will be used to develop extrapolations from existing data. Possible activities might include:

- Missing information on potential hydroelectric sources could require field investigation. Candidate rivers may have to be surveyed to identify potential

sites. These sites may have to be inspected at several times during the year to determine flow magnitude and variability.

- Missing information on the available wind energy resource could require the placement of anemometers to monitor wind velocity and variability over time.
- Missing information on the solar energy resource may similarly require the placement of solar radiation monitoring equipment in the field.

All field resource assessment work would be conducted in consultation with Hydro-Québec, Environment Canada and other appropriate organizations.

It may be possible to acquire missing data on other topics in the information base through the use of (1) modest experiments in the field, (2) engineering calculations and studies, and (3) interviews with the population.

At the conclusion of this activity, base-line information will have been developed in the various areas discussed above for all fourteen northern Québec communities. Additionally, indepth information will have been gathered for the two communities where pilot community energy planning activities are to take place.

2.1.2 Development of Energy Plans for Pilot Communities

In keeping with the principles of the northern Québec energy planning and demonstration project, we plan to develop a participatory energy planning process on a community-by-community basis. In Phase I, a full-scale energy plan will be completed for each of the two pilot communities. While some energy use statistics and projections have been developed for the region in the past, these studies have not been done by the people in the region and do not

reflect the needs perceived by the communities. Accordingly, the development of energy plans for the two pilot communities are «how-to» exercises; they will help us learn how to accomplish community energy planning for ourselves. The process will be fully documented so that it can be replicated by the other twelve communities in the region, as part of Phase II.

Each individual community energy plan will be able to stand alone as a planning document for the community. When all fourteen plans are completed, they can be combined to form part of an energy plan for the Kativik region. This will be an essential planning tool to Kativik Regional Government, Makivik Corporation and other organizations concerned with energy and economic development problems of the region as a whole.

Local participation in energy planning is a new concept in northern Québec. While local and regional participatory energy planning activities have been increasingly used in the south, there are some differences between those and the proposed northern Québec efforts. The fourteen Inuit communities of the region are unique in their remoteness. Because the communities are physically isolated from each other, there are not very many areas where it is necessary to look at them in conjunction with each other in energy planning. For example, it is not practical for communities to develop generating plants jointly, because the distance between the communities is too great and it would be too costly to transmit energy from a shared plant. While the boundaries of these Inuit communities are sharply defined, in less remote communities (most of the south), it is more difficult to define the boundaries of the study and to quantify the energy moving in and out. In the south, energy comes in a large number of forms and from multiple suppliers. In northern Québec, all the fuel supplied is in the form of oil or gas and delivered through a single distribution network. In these communities, a greater degree of accuracy can also be expected in

input data because field data collection can be more thorough due to the small size of the communities. It would not be too difficult to examine first-hand, every energy use in a given community.

Our approach to energy planning for the northern Québec communities is to view energy as only a means to and end. Producing and using more and more energy is not the goal; the goal is to have enough energy to accomplish the tasks that are needed and wanted in the community. Therfore, we must begin by defining the community needs for energy, based on past and present consumption data, as well as the short and long-term future needs expressed by the community itself.

We will also base our planning on the concept of energy «end-use matching». This concept takes energy «quality» as well as quantity into consideration. Every unit of energy is not the same in terms of the useful work it can do. We will match the quality of energy produced to its most efficient end use. For example, electricity should only be used for tasks that require this «high quality» form of energy, such as lighting and motors. Space heating needs, on the other hand, can be met with lower quality energy. This matching is important because the higher the quality of energy, the more expensive and less efficient it is to produce.

The community energy planning process will begin with the identification of energy flows through the community, using the energy supply and use data developed under the previous activity described in this proposal. Then, taking into consideration the principles we have outlined, we will examine where we can reduce non-renewable energy consumption and substitute renewable energy use for non-renewable use as much as possible. The procedure we will use is based on techniques used in numerous community energy planning activities which have taken place over the past four years all over North America. In summary, the steps will be as follows:

Step 1. Tabulate present community energy consumption: The energy flows through the community will be identified from supply to end-use. This will be both tabulated and illustrated in an energy flow diagram. Disaggregated consumption figures will be calculated and tabulated by end-use in:

(1) end-use energy delivered to need (in joules)* (2) fossil fuel equivalent imported into community (in litres) (3) primary (source) energy (in joules).

These end-use figures will then be summed to calculate present community energy consumption in total and by major sector. The current year costs of this energy consumption will also be computed.

Step 2. Project future energy consumption based on present use: using the present energy consumption figures as a starting point, future energy consumption will then be estimated for five, ten and twenty-five years from now using a «business as usual» set of assumptions. That is, current trends will be extrapolated into the future. Population will be assumed to grow at the rate projected in other current studies. Per capita energy consumption will be expected to continue to rise. It will be assumed that all energy will continue to be imported fossil fuels and that no major conservation measures will be

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* A joule is an electrical unit, the amount of work done or heat generated by a current of one ampère acting for one second against a resistance of one ohm.

implemented. This set of assumptions will be as realistic as possible, given the rapidly changing nature of the northern communities. Although it uses some fairly rigid projections, it is a useful figure for comparison purposes. It will present the «worst case» scenario.

Step 3. Project potential energy savings through conservation: The next step in the planning process is to examine each end-use of energy in the present and future energy consumption scenarios and determine the potential reductions which could result from either «moderate» or «aggressive» energy conservation implementation plans. Conservation measures will be evaluated with respect to savings at all three energy levels - end-use energy, fossil fuel imports and primary energy. All possible conservation measures will be considered, including better matching of energy sources to end-uses, equipment efficiency, cogeneration, building heat loss reduction through conservation retrofits and improved new construction, transportation conservation and maintenance practices. The optimum economic level of conservation for each end-use will be estimated and the potential savings for each end-use will be calculated for five, ten and twenty-five years from now, in both the «moderate» and «aggressive» conservation scenarios. The comparison of the «business as usual» with these two «conservation scenarios» will give a good case-by-case estimate of the individual and aggregate benefits of adopting various conservation measures.

Step 4. Project renewable energy development: The objective of this step will be to select, size and project the energy production of appropriate renewable energy systems over the same five, ten and twenty-five year periods. Candidate renewable energy tecnologies identified in other Phase I studies will be investigated to determine their feasibility for the two pilot communities. Selection criteria discussed later on in this proposal will be used to prioritize energy generation options and evaluate their costs and performance. Scenarios of both «moderate» and «aggressive» renewable energy investment levels will be used to develop projected energy generation figures for the selected renewable energy systems. These figures will then be combined with the savings projected in the «conservation scenarios» to calculate the range of remaining fossil fuel imports required.

Step 5. Develop implementation plan: This step will develop an implementation plan to meet the selected goals of conservation and renewable energy utilization in the communities. It will include timetables, cost estimates and a step-by-step plan for how conservation and renewable energy technologies will be introduced and implemented in the communities. This will also include detailed planning of the major Phase II demonstrations (discussed in the next section of this proposal) for the pilot communities.

2.2 Demonstration

The northern Québec energy planning and demonstration project proposes a range of demonstration activities over the duration of both Phase I and Phase II. These will begin with simple demonstrations of proven conservation technologies, progressing to one or two major renewable energy demonstration projects in Phase II. As discussed below, selected demonstrations must be technically and socially appropriate for the communities in the region. While this proposal can discuss the likely demonstrations which will be undertaken, the actual decisions, including selection of technologies and scale and location must be made by the communities, with the assistance of Kativik Regional Government and Makivik Corporation and the aid of information gathered in Phase I studies.

While Phase I activities, studies and demonstrations largely constitute the thrust of Phase II, we feel it is necessary to include both of them in the present proposal. The E.M.R. advance information on Remote Communities Demonstration Program makes a distinction between the two phases of the program along study/demonstration lines, but we believe some study and demonstration activities should take place, simultaneously, in both phases of our program. Reasons for including some demonstration activities in Phase I include:

- As discussed elsewhere in this proposal, the program will gain greater community involvement and support if it can show some short-term, tangible results. It is critical that it be perceived as more than «just another study».

- Previous energy conservation activities in the region have been very limited and dispersed. A number of proven, high-benefit conservation techniques can be identified and moved to demonstration in a very short period of time.

- Due to the generally poor condition of buildings and lack of previous conservation measures, there is a pressing need which available resources should not be delayed from addressing during a two-year study period.

- The proposed training of Community Energy Specialists must largely be «hands-on» training, followed by supervised «on-the-job» training in the one or two communities selected for Phase I field work.

- Inuit training and technical involvement in the project during Phase I is necessary to provide a basis for the desired substantial level of Inuit involvement in Phase II demonstrations. The proposed Phase I demonstrations and other field activities will provide a vehicle for both the Inuit trainees and the population in general to become more knowledgeable about energy use, supplies and conservation/renewable energy options. To the extent possible, this knowledge should be first-hand, not academic.

2.2.1 Selection of Technologies for Demonstration

The selection of renewable energy and conservation technologies for demonstration will be a critical focus of Phase I studies. Two levels of selection will be made. Early in the Phase I studies, a number of simple, proven conservation techniques will be selected for pilot application as part of the training of Community Energy Specialists. These will be technologies which can show immediate results, have minimal training requirements, and obviously meet the selection criteria described below. The selection of these pilot demonstrations will be made by the project staff, with input from community members and the concurrence of Kativik Regional Government and Makivik Corporation.

The technology selection process for the Phase II demonstrations will use the results of Phase I studies and evaluations of energy demand, resources, options, impacts and technical feasibility to develop a list of technologies appropriate for the communities. One or more of these will be selected for major demonstration in Phase II. The selection of Phase II demonstrations will be made by Kativk Regional Government and Makivik Corporation, after an extensive program of consultation and information exchange with the population of the communities. Information will be presented to the communities in a number of ways including public meetings, radio and television, and information circulars, regarding:

- descriptions of various conservation and renewable energy technologies which may be appropriate: what they are, what they can do, technology state-of-the-art, and so on;

- the results of Phase I energy use and energy resource studies;

- reliability, durability, health and safety aspects of the candidate technologies;

- potential environmental, cultural and social impacts of the candidate technologies;

- likely employment and other economic impacts of the candidate technologies.

All documentation will be in Inuktitut, English and French.

This consultative process, which identifies appropriate technologies for the region and selects those for application in both Phase I and Phase II, will be guided by an evolving set of selection criteria.

Energy efficiency, lower cost and the reduction of oil consumption are not the only possible benefits on which to evaluate the merits of various candidate technologies. There are other, very important benefits which could be achieved, including better health, increased employment and improvement of the quality of life. The benefits of each technology must be considered, weighing these benefits against their costs, including potential negative impacts. The evaluation criteria which have been identified at this time are expected to evolve over time, but at this time include the following:

- Technologies and projects that use them should minimize negative environmental, cultural and social impacts upon the region and its inhabitants;

- Technologies and projects should not substantially interfere with or negatively affect traditional activities of the Inuit in the region.

- Technologies should be proven and have a high likelihood of successful application in the northern Québec environment.

- Technologies and projects should maximize Inuit involvement and employment in design, construction and continued operation and maintenance.

- Technologies and projects should maximize the use of existing skills in the communities of the region.

- Technologies will be preferred which are of interest and use and acceptable to the inhabitants of the region.

- Technologies will be preferred which support increased energy self-reliance of communities in the region, rather

than reliance on fuels, equipment, or labour which must be brought in from outside the region.

- Technologies will be preferred which have the lowest maintenance requirements. They should be as reliable and durable as possible, and when maintenance is required, it should be easy to perform. When the technologies break down or otherwise fail, their failure should not harm their environment, nor should it cause major damage to the device itself.

- Technologies and projects should promote improved health and safety of the population, and have a positive impact on the quality of life.

- Technologies and projects will be preferred which will result in long-term job creation for the Inuit and economic development through the development of energy supplies which are of greater magnitude, lower cost and improved reliability than those presently in use.

No technology or project is expected to best meet all the criteria listed above. Some choices will have to be made. For instance, the otherwise desirable capacity of an energy generation project may have to be reduced to assure an acceptably small environmental impact, or a less efficient technology chosen due to its greater reliability.

2.2.2 Candidate Energy Demonstrations and Related Outreach Activities

Phase I

As discussed previously, pilot energy conservation demonstrations will be undertaken as part of Phase I of the R.C.D.P. Selected demonstrations will be those that are relatively modest,

low-cost, have immediate impact, are well understood and obviously meet other preliminary selection criteria without detailed assessment. These pilot demonstrations will initially be limited to energy conservation measures for existing buildings. The preliminary list of demonstrations and related activities under consideration includes:

(a) Energy Audits - A preliminary focus of the Community Energy Specialist training will be training to conduct simple building energy audits. Existing energy audit techniques used by other programs across Canada can be easily adapted for use in the communities of northern Québec. The «training» section of this proposal further discusses the skills that will be taught and used in this activity. All of the buildings in the two Phase I pilot communities will receive an energy audit, which identifies and prioritizes the most appropriate and cost-effective energy conservation improvements for each building. In the other twelve communities of the region, similar energy audits will be completed on 50% of the buildings by the end of Phase I. Experience gained by the project staff in conducting the energy audits in the two pilot communities will provide feedback for the training of additional Community Energy Specialists to conduct audits and demonstrate conservation measures in these other twelve communities.

(b) Oil Burner Maintenance - The measure which can probably result in the quickest and lowest-cost reduction of oil use in buildings without behavioural changes is frequent, competent maintenance of oil heating systems. Conducted by the Community Energy Specialists, this maintenance will include, as appropriate for each unit:

- furnace inspection
- cleaning and lubrication
- changing and cleaning of air and oil filters
- safety controls and considerations
- burner adjustments
- circulating fan speed and on-time adjustment
- nozzle replacement and derating
- outside combustion air supply
- replacement, high-efficiency components

Appropriate maintenance measures will be performed on 30% of the primary heating systems in the two pilot communities and on secondary oil burners in buildings where there are back-up or supplemental units. By the end of Phase I this maintenance is also expected to have begun in the toher twelve communities, with the goal of having routine maintenance for all heating systems in all communities within two years of project initiation. The benefits of this activity will be not only in lower oil consumption, but also in improved reliability of heating systems, and higher quality, more rapid service in the future, from locally available personnel.

(c) Infiltration Reduction - Building construction in northern Québec is notoriously leaky. This is a major contributor to building heating loads which are met with imported oil. Much of this leakage can be easily eliminated through the use of caulking, weatherstripping and other infiltration reduction techniques. This is a relatively inexpensive and visible demonstration of energy conservation which will both reduce oil consumption and improve thermal comfort. Materials will be chosen with particular consideration of the harsh environment, durability and ease of installation.

As the infiltration of buildings is reduced, indoor air quality may suffer. Humidity, which is already a problem in many homes, may become even more of one. Tobacco smoke and odors may build up undesirably. These problems may require more use of controlled ventilation, possibly employing heat recovery and particularly when there are any possible negative health affects.

Installation of some infiltration reduction measures is anticipated in 20% of the buildings in the two pilot communities as part of Phase I. Two to four buildings in each of the pilot communities will be used for pilot application of more extensive infiltration reduction measures and examination of associated indoor air quality issues. Use of controlled ventilation devices may be considered, and if they are used they will be monitored and evaluated. Infiltration measures are eventually anticipated to be installed in the other twelve communities, but not during Phase I of this project.

(d) Glazing Improvements - Windows are the primary area where conductive and radiative heat losses occur in buildings. While some new buildings in the region are being built with triple glazing, most buildings could reduce oil use substantially and improve the indoor thermal environment through glazing improvements. A variety of techniques are potentially useful:

- storm windows of glass or plastic, including multiple-glazing types, for both seasonal and permanent installation

- thermal shutters and shades which improve the night-time insulating value of the windows (these might be locally fabricated)

- replacement windows using either conventional multiple glazing or new, high-performance glazing systems.

(e) No-Cost Conservation Practices - Significant reductions in oil use can be achieved at no cost through the adoption of energy-conserving practices in buildings. These may be particularly difficult to introduce in northern Québec because the population may not necessarily perceive an incentive to reduce heating oil consumption. Despite this situation where individuals may not pay the full cost of heating oil, it is felt that the indirect benefits of reduced oil use can be made understandable, as can the benefits of improved heating system reliability, greater thermal comfort and improved health which can result from energy conservation practices. This will require a carefully developed community information and outreach program, extensive Inuit involvement and participation. The energy conservation practices appropriate in the south may not be appropriate for the Inuit communities of northern Québec. The introduction of energy conservation practices is not merely a technical or logistical problem, nor is it a problem of just explaining what to do. It must be approached freshly and innovatively, with full consideration of the history, culture, expectations, daily activities and other social aspects of how the people in the communities relate to their housing and use of energy. The determination of which energy conservation practices are appropriate and how to most effectively promote them must be made by those with this kind of awareness - the project staff from and the inhabitants of the communities. They will use their own experience and knowledge, together with input from project technical experts, to develop and implement this aspect of the program.

For the reasons discussed above, the types of practices which will be the subject of this program cannot be predetermined. They may be unique to this environmental and social context, or they may be more conventional measures, for example:

- thermostat lowering and/or setback
- use of drapes or blinds
- hot water conservation
- conservation measures in cooking
- appliance conservation measures
- lighting conservation measures
- plugging infiltration openings.

Similarly, the strategies for promoting these measures must be determined through a consultative process, but might include:

- discussion during energy audits
- presentation or demonstration in schools, from where children may carry ideas home
- informational booklets or flyers
- publicity about success of demonstrations
- use of radio, cartoons, television, other media
- adult education
- public meetings.

(f) Public Building Demonstration - In each of the two pilot communities, a public building will be identified to receive special emphasis in conservation demonstrations. By using a public building, more people will be exposed to the conservation techniques being demonstrated. Informational signs, posters and literature can be used to both describe and discuss the demonstrations. Such

buildings will also provide ideal locations for measurement and evaulation of techniques, without disrupting individual households. To this end, project technical experts will develop and supervise experimental evaluation of the performance of selected conservation technologies. Results will provide valuable feedback on the application of these technologies in northern communities to Energy Mines and Resources, to other northern communities and to the northern Québec energy planning and demonstration project as plans are made for Phase II activities.

Phase II

As mentioned above, the major thrust of Phase II activities is the design, development and installation of one or more major renewable energy demonstration projects. The results of Phase I studies and evaluations of energy demand, resources, options, impacts and technical feasibility will be used to generate a list of technologies suitable for the communities in this project. Technologies which, from the perspectives of preliminary assessment and current proposer understanding of the subject area, are potential candidates for Phase II demonstrations are discussed below. This list of candidate technologies is not comprehensive. It is intended only as a shopping list to be augmented or reduced through a process of community consultation as the results of Phase I activities are analysed and become more clearly focussed. The technologies eventually selected for demonstration in Phase II must be systems proven in environments not too dissimilar from northern Québec. They will be subjected to the evaluation criteria outlined in section 2.2.1 above. Potential demonstrations include:

(a) Energy-Efficient Buildings - The focus of this demonstration will be the design and construction of new and add-on building systems which stress energy conservation and passive solar features to reduce the use

of conventional fuels for space heating. Energy conservation features could include improved or «superinsulation», controlled ventilation (possibly using air-to-air heat exchangers) and use of vapour-tight construction and night-time glazing insulation techniques. Passive solar features, such as direct gain and mass wall systems, could be employed to substantially reduce heating loads during the spring and fall.

This demonstration project would work closely with existing and planned activities of Société d'Habitation du Québec in renovation and new home construction, as well as in the development of improved standards for building construction in northern Québec.

(b) Micro/Small Scale Hydro - Micro and small scale hydro systems have the potential to generate power to meet a significant portion of the electricity needs for several of the communities in northern Québec, especially those located near the Caniapiscau, Koksoak, Payne, George and other rivers. A suitable site near one of the Inuit communities could be selected and developed in conjunction with Hydro-Québec. Hydro-Québec's pre-feasibility and feasibility studies on potential small scale sites in the region will be used to make preliminary site and system assessments. Systems ranging from 50 kW to 3000 kW will be considered.

(c) Windmills for Electricity Generation - Wind energy conversion systems will not be able to generate electricity to meet the base load requirements of any of the communities in this project, due to the periodic nature of the wind. However, given the abundance of wind in some of the coastal communities, wind power has the potential to

substitute for a signficiant proportion of the diesel-generated electricity currently being used, when wind conditions are favourable. A suitable site and wind energy conversion system could be selected, again in conjunction with Hydro-Québec, to demonstrate the economic and technical feasibility of using windmills for power generation in remote northern communities.

Another potential application for wind power in these communities is the generation of hot water, using either mechanical agitation or low-quality (unregulated) electricity.

(d) Solar Photovoltaic Systems for Generating Electricity - The current cost of generating electricity in northern Québec would appear to make photovoltaics a potentially viable substitute for diesel-generated electricity. Residential and public building electricity needs of any type could be met by commercially available photovaltaic systems with battery storage or hybridization with fossil fuel systems. Due to the very limited availability of solar radiation in the winter, and its variability at other times of the year, any photovoltaic applications would probably be limited to use as a substitute generating system, on an as-available basis. In addition to this limitation, panels would probably have to track the sun on long summer days, a requirement which could be costly and affect reliability. On the other hand, a photovoltaic system would likely provide a more reliable and larger annual electricity output than a similar cost and size wind energy conversion system. Systems for a few buildings (eg. a sport hunting or fishing camp) up to community systems will be considered.

(e) Solar Thermal System - Solar water heaters may eventually prove to be a useful and cost-effective technology for demonstration purposes in northern Québec communities. However, the limited current use of heated water, the cost and reliability of freeze-protection systems and the seasonal variations in solar energy availability all tend to mitigate against this as a likely candidate demonstration technology. Active solar space heating systems suffer from some of these same problems and do not compare favourably with the potential of passive systems, mentioned as likely demonstrations in item (a), above.

(f) Greenhouses for Food Production - The use of greenhouses to raise food, and horticulture in general, would be major new technologies in northern Québec communities, and may not be socially acceptable. If Phase I investigations conclude that this is a technology of interest to the communities, a pilot demonstration project could be executed similar in magnitude and scope to projects currently underway in Alaska and other areas of northern Canada. Waste heat, such as that associated with diesel-powered electric generation, has been demonstrated to be good primary or back-up (to solar) heating systems. Greenhouses ranging in size from single-family to small commercial units will be considered.

(g) Waste Heat Recovery - Diesel generators and other electrical, mechanical and thermal systems which exhaust heat can be designed or adapted to permit recovery of that heat and its useful application to meet heating needs such as space heating. This heat could be used to heat community or commercial buildings year round and greenhouses during the spring and fall. Use of waste heat

recovery will be considered for all scales of generation and use, from family-sized power or heat generating systems to community-sized electrical power plants.

(h) Use of Community/Domestic Refuse - Refuse and household sewage can be used to generate energy. The DIAND/Pluritech prefeasibility study for Inukjuak indicates the types of systems that might be considered. None of the communities generate large quantities of biodegradable material, either in the form of garbage or solid wastes from sewage. Nevertheless, the processes of garbage and sewage collection and disposal in the communities, and the limited use of water in household sewage indicate that generation of methane and incineration of suitably treated solid wastes may be viable options, primarily as substitute fuel sources for electricity and heat generation.

Several other areas which have been considered and dismissed (at this time) as unlikely areas for energy demonstrations include tidal energy, geothermal energy, wave energy, nuclear energy, and biomass energy other than from community refuse. These systems have been screened out of preliminary consideration for one or more of the following reasons:

- lack of available energy resource in the region
- insufficient technological development
- potential environmental and social impact
- safety and health
- unproven technology, at appropriate scale or at any scale.

2.3 Training

Training is a central part of the present proposal and is built into all aspects of the project, ranging from transfer of mechanical skills to transfer of more elusive «quality of life» and «comfort» skills. It is recognized that the technology must be acceptable to the participants within the framework of their culture. No one can determine what is suitable or appropriate other than those who will be using the information and technologies. Consequently, Inuit participation in planning, identification of research areas, development of information and skills, is an integral part of this proposal.

At all stages, emphasis will be on developing broad-based community involvement, and easy access to all information generated. Training people within the community ensures that the skills will remain there and be disseminated to others. To have a long-term impact, skills must become part of the basic resources of that community.

2.3.1 Objectives of Training

Realizing the vital importance which the training component holds for the design, implementation, maintenance and continuity of use of the information and technologies generated during and following the course of this project, we will develop an integrated approach to training which will:

- maximize use of existing community skills in the areas of policy planning, technical capabilities, administration and delivery of extension services and education

- provide further, critical short-term education within analytical, technical and extension education skills through training programs in two of the communities

- develop a set of technology and information related skills which will remain in these communities and thus be available for ready expansion to other northern Québec communities.

- develop a self-generating training capability within the communities of northern Québec.

2.3.2 Approach to Training

Phase I of the project deals with initial field and demonstration studies aimed at identifying areas suitable for further research for implementation of energy conserving and alternate energy systems. Because this is the exploratory phase of the project, training and demonstration will be limited to one or two pilot communities. Criteria for choosing these communiites will be based upon size, availability of people to take part in the training program and ease of replicability for other communities.

At project start-up, it will be the responsibility of the program coordinator to become familiar with the pilot communities selected, their members and their political and administrative structures. The coordinator will investigate and assess the level of community skills and expertise within:

- technical design and mechanical capabilities
- conservation and renewable energy use
- instructional and extension services.

Recognition of existing skills and the potential adaptability of these skills will be a priority and efforts will be focused on maximizing use of these skills. The community itself, through the project, will be encouraged to look at traditional skills that have been ignored or supplanted with the advent of new

technologies. By looking at traditional ways of dealing with a harsh, northern climate, program trainees can begin to identify possible solutions for the present. The best systems could be a blending of traditional resources and techniques with newly acquired knowledge and skills to arrive at the most appropriate and acceptable solutions. This approach goes beyond practical considerations to recognition that the wealth of information stored within the community is itself a renewable resource, as long as it is encouraged and continues to be used.

The assessment of community skills and expertise will further serve to gather together existing information, materials and curriculum plans, to line up potential trainers and to identify the most critical information gaps and training needs. Existing and proposed training programs will be assessed to determine the need for, level of, and modes of collaboration.

The training program will be approached as a learning experience for both trainers and trainees. Exchange of information will be encouraged from both directions so that information flows horizontally rather than from the top-down. Job-creation will be stressed, since the skills to be transferred are ongoing, dynamic ones that will continue to have relevance in the community.

By project termination it is anticipated that the systematic training compenent would have aided in the creation of:

- a northern Québec community awareness at all levels - institutional and private, family and community wide - of the purpose of and need for energy conservation and renewable energy development.

- administrators trained in community energy policy planning evaluation and management

- specialists trained in energy assessment and planning, design, installation, monitoring and servicing energy conserving and renewable energy systems. In addition, these specialists will be knowledgeable about the various technolgoies and versed in the specifics of technology transfer issues and delivery methods relevant to northern Québec communities.

2.3.3 Development of Community Energy Specialists Training Program

Within the pilot communities, people will be sought who are interested in participating in the training. Language plays a vital part in the way information is imparted. It is important that this be done in the language of the people so that the information becomes part of their resource base rather than always having the flavour of an imported item. Initially, the bulk of training will probably have to be done in English and Inuktitut, necessitating some fluency in one of those languages on the part of the trainees. As soon as it is feasible, further training, particularly beyond the initial communities, will be conducted in Inuktitut so that more people will have access to the information and it can be more widely disseminated.

Insofar as possible, a flexible approach will be taken as to who is hired for training. Since trainees will likely be implementing some of the information as demonstrations in their own homes, efforts should be made to identify those people who are most likely to carry through with the project. In general, trainees should be respected and well-regarded members of the community. This tends to increase the likelihood that their involvement will be appreciated by other members of the community. Trainees need not have former skills in identified training areas. Greater emphasis will be on reliability, interest and position in the community. It

is easier to teach skills than it is to alter established relationships within the community.

Two trainees will be selected from each of the two pilot communities using the general selection guidelines suggested in the section above. These four persons will be trained as Community Energy Specialists. In addition to ultimately providing two trained specialists for each of the pilot communities, it also ensures some protection for the program in case of trainee drop-out or illness during the course of the project.

Trainers for the Community Energy Specialists will be provided first from within the pilot community in areas where the appropriate expertise is available, then from within the broader northern Québec region and finally from a cadre of outside short-term consultants where necessary. Trainers will be selected on the basis of their technical and educational skills, and sensitivity to information and skills transfer in northern Québec communities.

Other training programs currently underway or proposed specifically in the two pilot communities and in the northern Québec region will be identified and evaluated to determine the relevance of, need for, level of and modes of collaborative effort. Such programs might include the fields of electrical and machine operator skills development, construction training, community organizing and job retraining.

As part of the training program and a more comprehensive community awareness and education training program, a systematic collection of materials relating to all aspects of the energy demonstration project will be instituted. This collection of materials will be housed in a library of convenient and accessible location. The library will organize solicited materials according to technical, training and extension techniques utilized by energy

specialists in other areas of the world. The collection of materials will provide a wealth of information on the design and delivery of tools and techniques. Initially, most of the information in the resource library will be in either English or French. However, as the project progresses, the most frequently referenced texts will be translated into Inuktitut. All training manuals developed as part of the training program and all working papers or documents developed from specific technical or social and economic studies will be prepared directly in Inuktitut.

The initial training program for the Community Energy Specialists will be undertaken over a 3 1/2 month intensive period in one of the pilot communities. The specialists will be trained in each of the selected demonstration technologies and in techniques to facilitate extension and community involvement in successful application of these technologies. The primary stress will be on hands-on training, using models and identified community or private buildings as training aids. Training will focus on items which show immediate results. These areas are discussed in the Phase I Demonstration Program above.

The degree of competency developed will vary according to the various demonstration technologies, however the overall purpose of training will be to assure trainees are capable of:

- identifying and analyzing what is needed in each of the specified project demonstration areas, and the problems inherent in the existing mode of operation;
- understanding principles of energy conservation;
- creative thinking and design manipulation
- utilizing tools and techniques best suited to the technology
- evaluating the structure, efficiency, ease of use and social acceptance of the technology through actual operation;

- design and utilization of a record keeping system for performance measures and servicing
- maintaining an adequate supply and system of obtaining materials and parts
- trouble-shooting a defective technology and servicing and maintaining an effective unit
- explaining the design theories and workings of the technology, its appropriate operation
- training others in the above techniques.

Some of the training is obviously of a technical nature; some socio-economic. The two are inseparable.

Upon completion of the 3 1/2 month training period the Community Energy Specialists will undergo a further 2 weeks of intensive on-the-job supervision in their respective communities.

At the end of this period they will be capable of undertaking all aspects of the Phase I demonstration projects in their respective communities. Further on-the-job training will be supplied as necessary. Follow-up evaluation and training will be built in to occur at regular intervals throughout the duration of the project. The Community Energy Specialists must have a thorough grasp of the purpose of the project, must be familiar with a minimum of the theory and with the design, construction or installation and maintenance of the technologies and must be familiar with and willing to experiment with traditional and new methods and techniques.

As the training sessions are conducted, training manuals will be developed by the Project Coordinator and the consultant with technical and editing assistance. This will be a continuing process to enable updating in terms of technological changes, materials development and training procedures. A final training manual will be completed towards the end of the 3 1/2 month training period and will

be written in Inuktitut, English and French. Editing, printing, layout and photographic content of this manual have all been provided for in the cost projections under section 4 of the present proposal.

As the Community Energy Specialists are trained in each technology, Kativik, Makivik and community representatives will be briefed in the technology and training process, will be invited to attend training sessions and will be encouraged to participate in the planning, execution and evaluation of training segments. These representatives will receive additional planning and management seminar training in each technology, as it is introduced. These seminars will discuss the infrastructural issues of planning techniques needed to assure adoption and dissemination of technologies, support structures for continued maintenance and operation, budgeting and programming for program extension.

It is anticipated that the Community Energy Specialists will be used as trainers in any subsequent expansion of Phase I of this project to other communities and in the Phase II demonstration projects.

3. PROJECT MANAGEMENT (PHASE I OF R.C.D.P. PROGRAM)

As the energy planning activities and demonstrations proposed in Phase I of this project will establish a basis for energy planning in northern Québec, it is of the utmost importance that the various interested energy players of the Region collaborate in the project implementation. Ideally, these players, or participating organizations, could collaborate through submission of a joint or cost-shared proposal to be negotiated and work together throughout all aspects of the program. For example, such participating organizations could include Hydro-Québec and Société d'Habitation du Québec (S.H.Q.).

Kativik Regional Government shall assume overall financial and administrative responsibility for the project in consultation with any other participating organizations.

3.1 Project Personnel

The personnel required for the project would be as follows:

a) Project Coordinator - A full-time coordinator and a part-time assistant for all aspects of project implementation would be chosen jointly by Makivik Corporation and Kativik Regional Government. The candidates will be chosen on the basis of project management criteria developed by these bodies. Specific responsibilities of the project coordinator will include:

- development of an information base; - development of an energy plan - implementation of demonstrations chosen for Phase I; - training of energy specialists in the pilot communities;

- participation on the Advisory Committee; - budget management.

The Coordinator will be responsible for regularly consulting with the participating organizations and will submit drafts of reports and studies for review to Makivik Corporation, Kativik Regional Government and the Advisory Committee.

b) Assistant - As mentioned above, a part-time assistant will work with the Coordinator and assist in carrying out his mandate. Duties will include: assisting the Coordinator in his research, report writing, organization of meetings, training of energy specialists and so on.

c) Consultant - A consultant will be required for the initial training program of four community energy specialists: two in each of the two pilot communities. The consultant, under the supervision of the Coordinator will be responsible for undertaking a four month intensive training program for the community energy specialists. The estimated period of four months work for both pilot communities includes preparation, travel times and actual training. The Consultant will be selected by the Project Coordinator in consultation with Kativik Regional Government and Makivik Corporation.

d) Community Energy Specialist Trainees - Four trainees for the two pilot communities (two trainees for each community) will be chosen on the basis of the criteria mentioned above in this proposal.

3.2 Project Organization

Each participating organization will designate a resource person who will constitute a member of the Advisory Committee. The

Advisory Committee will be available to the Project Coordinator for consultation, advice and information. The resource person will also review drafts of reports and studies submitted by the Project Coordinator. We estimate that the amount of time required for each resource person will be approximately 3 days per month.

It is hoped that office space and support staff for the Project Coordinator and the assistant can be made available by one of the participating organizations. Depending on such contributions the proposed cost projections below can be adjusted accordingly. Due to the nature of the program, which will require extensive community consultation, a permanent head office in the north is necessary, possibly in the Kativik Regional Government or Makivik offices. A location should also be made available in Montreal when needed by the Coordinator. Office space in a central northern point like Kuujjuaq could constitute a contribution to the present program by Kativik Regional Government or Makivik.

3.3 Schedule

The following time frame is contemplated for implementation of the present proposal:

1.	Selection of Project Coordinator, consultant, assistant and office location and pilot communities by Makivik and Kativik Regional Government in conjunction with possible participating organizations:	4 weeks
2.	Data base - survey of existing information:	6 weeks
3.	Identification of gaps in data base:	2 weeks
4.	Data base - gathering or development of missing information:	4 weeks
5.	Preparation of report on baseline information:	3 weeks
6.	Development of energy plan for pilot communities:	6 weeks
7.	Demonstration and training - two pilot communities:	4 months

8. Preparation of report on demonstration and training:	1 week
9. Preparation and presentation of overall results of R.C.D.P. project (Phase I):	2 weeks
Total Period:	56 weeks

4. COST PROJECTIONS

A) Salaries:

1. One Project Coordinator (1 year)

- Salary	$ 32,000.	
- Northern benefits	7,121.	
- Fringe benefits	2,380.	
- Housing	12,234.	
- Annual leaves	1,424.	
- Cargo	1,410.	
	$ 56,569.	$ 56,569.

2. One Assistant to the Coordinator (1 year) $ 25,000. 25,000.

3. One Consultant (Energy Specialist Trainer) (6 months)

- Salary	$ 16,000.	
- Housing	6,117.	
	$ 22,117.	22,117.

4. Four Community Energy Trainees (4 months X $1,500. per month per trainee) $ 24,000. 24,000.

TOTAL: $127,686.

B) Travel Expenses

1. Project Coordinator

- Airfare (12 X $700.)	$ 8,400.	
- Lodging, Meals, etc. ($362 X 12)	4,344.	
	$ 12,744.	$ 12,744.

2. Assistant to the Coordinator

- Airfare (6 X $700.)	$ 4,200.	
- Lodging, Meals, etc. ($362 X 6)	2,172.	
	$ 6,372.	6,372.

3. Consultant

- Airfare (4 X $700.)	$ 2,800.	
- Lodging, Meals, Etc. ($362 X 4)	1,448.	
	$ 4,248.	4,248.

4. Trainees		
- Airfare (approximately)	$ 20,000.	20,000.
TOTAL		$ 43,364.
C. Office/Project Expenses		
- Clerical staff	$ 15,000.	
- Supplies & Equipment	10,000.	
- Telephone	5,000.	
- Photographs	3,000.	
- Documents	2,000.	
- Printing	5,000.	
- Photocopies	2,000.	
- Editing and Technical Writing	4,000.	
TOTAL:	$ 46,000.	$ 46,000.
D. Translation Services	$ 10,000.	$ 10,000.
GRAND TOTAL		$227,050.